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Livingston Rail Yard indoor air quality investigation report

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LIVINGSTON RAIL YARD INDOOR AIR QUALITY INVESTIGATION REPORT APPENDICES

PLEASE RETURN

Submitted to:

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and Environmental Sciences
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Submittal Date:

March 27, 1992

ENVIROCON, INC.

APR 2 [illegible] 1993

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Appendix A

Field Activities Documents

Indoor Air Sampling Standard Operating Procedures

I. Adjust pump to low-flow range, if required.

II. Calibrate sampling apparatus.

  A. Calibrate precision rotometer using a bubble flow meter at the expected flow rate of 12.5 ml/min. Record the calibration in log.

  B. Calibrate the two air pumps (with two "dummy" sampler tubes attached) to a flow rate of 25 ml/min using the precision rotometer. Record the calibration in log.

III. Pre-sample instructions to be done at the residence.

  A. Record the following parameters in the field logbook.
    1. Sampling personnel.
    2. Sampling location.
    3. Outdoor ambient temperature.
    4. Local barometric pressure.
    5. Local relative humidity.
    6. Temperature where sample is collected.

  B. Assemble sampling train in residence.
    1. Put on sampling gloves.
    2. Carefully remove first sampler from glass test tube.
    3. Mark number from sampler onto glass test tube.
    4. Unscrew plastic plug from the pump end of the sampler and place plug in the glass test tube. See the attached figure.
    5. Carefully screw sampler ferrule nut onto sampling train "T", taking care to keep sampler fully inserted into "T".
    6. If a field blank is to be collected at the residence, the field blank sampler tube should be attached to the other side of the "T" as described in steps 2 through 5.
      a. Unscrew the plastic plug from the sample inlet end and place plug in the glass test tube.
      b. Replace the plastic plug to the sample inlet end.
      c. Unscrew the sampler ferrule nut from the sampling train "T" and replace the plastic plug.
      d. Place the field blank sampler tube (with end plugs in place) at the sample location.
    7. Repeat steps 2 through 5 above for other side of the "T".
    8. You should now have a large glass "T" attached through a needle adjusting valve to the sampling pump. Both ends of the samplers should still be sealed.

  C. Locate samplers centrally in room and at breathing zone.

D. Collect an approximately four hour sample.
  1. Turn on the pump and warm up for 3 minutes.
  2. Unplug the sampler ends, placing the plugs in their respective test tubes.
  3. Attach sampling train (needle valve, tubing, and stainless steel "T") to pump inlet, noting time and date in log.
  4. Attach rotometer tubing to open sampler end, adjust needle valve to approximately 12.5 ml/minute, record reading and sampler number in log.
  5. Repeat "4" above for other sampler.
  6. Take pre-sampling photo of samplers in place.

E. Set up second sample location in the residence following the steps outlined in A, B, C, and D above.

F. Fill out the sample log and home survey forms.

IV. Post-sampling procedures.

A. Take post-sampling photo.

B. Re-measure flow rates through each sampler with the precision rotometer and record in log.

C. Turn off pump and note time in log.

D. Immediately seal the open sampler ends with plugs from glass test tubes.

E. Unscrew ferrule nuts from "T", remove samplers from "T", and screw the plugs into the open sampler ends.

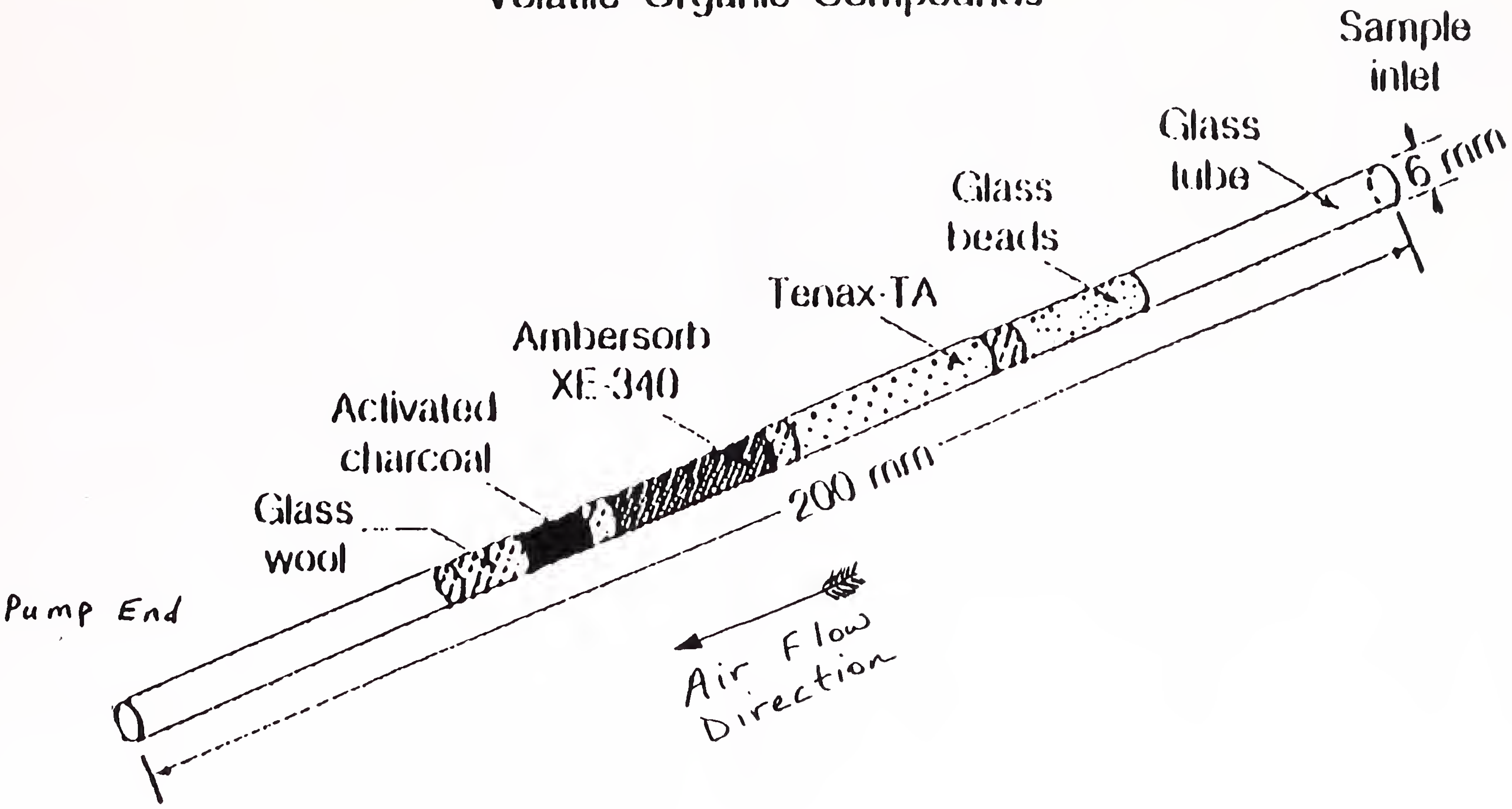
F. Place samplers in glass test tubes and seal (both ends of the samplers should be plugged).

G. Place glass test tubes in cooler with ice.

H. Collect and record in log the following information.
  1. Indoor Temperature.
  2. Local relative humidity.
  3. Local barometric pressure.
  4. Outdoor ambient temperature.

V. Pack samples with chain of custody forms and ship via Federal Express to Berkeley Analytical Associates. The sample volume (corrected to 25° C and 1 atm.) should be recorded for each sample on the chain of custody form.

Multisorbent Sampler for Volatile Organic Compounds



Completed Building-Structure Forms

Building-Structure Survey

Address BG-1

Name of person completing this form

Date 2/6/92

1. Approximately how many square feet does your basement cover? 350 ft^2

2. Please indicate the type of floor your basement has.

   X Cement
   ___ Bare earth
   ___ Cinderblock
   ___ Other (please describe) ___

3. Does your basement have any openings to the outside air other than the door leading to the rest of the house? [✓ yes] no If yes, please describe.
   window 1' x 2½ Draft ~~the~~ around window

4. Approximately how many hours a week do you spend in your basement? none

5. Are there any cans of paint, paint thinner, gasoline or other solvents being stored in your basement? If yes, please describe. Several CANS of Stain, floor enamal 2 gallons of paint, Round up Herbicide in plastic 1 gallon milk jug., Roof patch ~~seal~~ chaulking and 5 gallon can of ~~roof~~ coat.

6. Have you ever noticed any odors in your basement that you could not explain by the material you have stored there or by activities in the rest of the house? If so, please describe. Rubber smell from furnace (occassionally when running) ~~up~~ noticed upstairs.

7. Does your house have a crawl space? [✓ yes] no

8. If you do have a crawl space, approximately how many square feet does it cover? 400 ft^3 crawl space put in so the furnace could be installed see back for diagram

9. Does your household use natural gas for cooking? yes [✓ no]

10. Please indicate the type of heating system you use.

    [✓ Forced air natural gas]
    Natural gas heaters
    Electric
    Wood
    Other ___

12. Please describe the number of first floor rooms in your house. 7
    The approximate square footage of these rooms is 800 ft^2.

Building-Structure Survey

Address BG-2

Name of person completing this form

Date Feb 6 '92

1. Approximately how many square feet does your basement cover? 12' x 10'

2. Please indicate the type of floor your basement has.

   - ✓ Cement
   - ✓ Bare earth Crawlspace
   - ☐ Cinderblock
   - ☐ Other (please describe) ____

3. Does your basement have any openings to the outside air other than the door leading to the rest of the house? yes [✓ no] If yes, please describe.

4. Approximately how many hours a week do you spend in your basement? 15 min/week

5. Are there any cans of paint, paint thinner, gasoline or other solvents being stored in your basement? If yes, please describe. PAINT ONLY [Also noticed paint/varnish remover & Thompsons water seal.] See JM log book.

6. Have you ever noticed any odors in your basement that you could not explain by the material you have stored there or by activities in the rest of the house? If so, please describe. Sewer Vent backup 1½-2 yrs. ago.

7. Does your house have a crawl space? [✓ yes] no

8. If you do have a crawl space, approximately how many square feet does it cover? 6' x 6'

9. Does your household use natural gas for cooking? yes no

10. Please indicate the type of heating system you use.

    Forced air natural gas
    Natural gas heaters – not used since Feb '90.
    Electric
    [✓ Wood]
    Other ____

12. Please describe the number of first floor rooms in your house. Living Room, Bedroom, Bath, Kitchen & Utility Ro (Full Upstairs.)
The approximate square footage of these rooms is ~704 sq.'.

Building-Structure Survey

Address BG - 3

Name of person completing this form .

Date 2/12/92

✓1. Approximately how many square feet does your basement cover? 350-400

2. Please indicate the type of floor your basement has.

   X Cement cement in store room, carpeted family room.
   ___ Bare earth
   ___ Cinderblock
   ___ Other (please describe) ___

3. Does your basement have any openings to the outside air other than the door leading to the rest of the house? [✓ yes] no If yes, please describe.
   - furnace vent
   - sewer pipe exits through foundation; exposed soils.

4. Approximately how many hours a week do you spend in your basement? 10 hrs.

✓5. Are there any cans of paint, paint thinner, gasoline or other solvents being stored in your basement? If yes, please describe. Yes
   - several gallons of Latex paint, several partially filled gallon jugs of paint/varnish thinn

6. Have you ever noticed any odors in your basement that you could not explain by the material you have stored there or by activities in the rest of the house? If so, please describe. No

7. Does your house have a crawl space? yes [✓ no]

8. If you do have a crawl space, approximately how many square feet does it cover? ✓

9. Does your household use natural gas for cooking? yes [✓ no]

10. Please indicate the type of heating system you use.

   [✓ Forced air natural gas]
   Natural gas heaters
   Electric
   [✓ Wood] — Primarily
   Other ___

✓12. Please describe the number of first floor rooms in your house. 5
The approximate square footage of these rooms is 1000 ft². Total
Living Room 300 ft²

over

Building-Structure Survey

Address BG-4

Name of person completing this form

Date Feb 12 '92

1. Approximately how many square feet does your basement cover? 800 ft.²

2. Please indicate the type of floor your basement has.

   X Cement floor & walls.
   Bare earth
   Cinderblock
   Other (please describe)

3. Does your basement have any openings to the outside air other than the door leading to the rest of the house? [✓ yes] no If yes, please describe.
   3 WINDOWS

4. Approximately how many hours a week do you spend in your basement?
   1 HR. / week

5. Are there any cans of [✓ paint], paint thinner, gasoline or other solvents being stored in your basement? If yes, please describe.

6. Have you ever noticed any odors in your basement that you could not explain by the material you have stored there or by activities in the rest of the house? If so, please describe. NO

7. Does your house have a crawl space? yes [✓ no]

8. If you do have a crawl space, approximately how many square feet does it cover? —

9. Does your household use natural gas for cooking? yes [✓ no] Electric

10. Please indicate the type of heating system you use.

    [✓ Forced air natural gas]
    Natural gas heaters
    Electric
    Wood
    Other

12. Please describe the number of first floor rooms in your house. Kitchen, Living, 2 Bedrooms, Bath, Porch
    The approximate square footage of these rooms is 1200 ft².

Building-Structure Survey

Address BG-5

Name of person completing this form

Date 2/11/92

1. Approximately how many square feet does your basement cover? 400

2. Please indicate the type of floor your basement has.

   - ✓ Cement Floors & Walls
   - ____ Bare earth
   - ____ Cinderblock
   - ____ Other (please describe) ____________

3. Does your basement have any openings to the outside air other than the door leading to the rest of the house? [✓ yes] no If yes, please describe. 3 windows 2 small window

4. Approximately how many hours a week do you spend in your basement? 2-3 Hours / Day

5. Are there any cans of paint, paint thinner, gasoline or other solvents being stored in your basement? If yes, please describe. Yes. Paints / Solvents / Glues used in Crafts.

6. Have you ever noticed any odors in your basement that you could not explain by the material you have stored there or by activities in the rest of the house? If so, please describe. NO

7. Does your house have a crawl space? yes [✓ no]

8. If you do have a crawl space, approximately how many square feet does it cover? ____

9. Does your household use natural gas for cooking? yes [✓ no] (Electric)

10. Please indicate the type of heating system you use.

    Forced air natural gas
    Natural gas heaters (Hot Water Heaters)
    Electric
    Wood
    Other ____________

12. Please describe the number of first floor rooms in your house. Kitchen, Living, 2 bedroom Bath Porch
    The approximate square footage of these rooms is (23 x 14) (10 x 11) (6 x 10)

over →

Building-Structure Survey

Address NE-1

Name of person completing this form

Date 2-5-92

1. Approximately how many square feet does your basement cover? 600 ft² for THE TOTAL BASEMENT; Room where sample collected ~ 180 ft²

2. Please indicate the type of floor your basement has.

   ✓ Cement
   ____ Bare earth
   ____ Cinderblock
   ____ Other (please describe) ____________

3. Does your basement have any openings to the outside air other than the door leading to the rest of the house? [✓ yes] no If yes, please describe. old coal shoot in sample room and in middle room of basement. Floor integrity is good; there is 5'x1½' bare (no cement) patch in the concrete floor. Maybe a drainage sump → see back

4. Approximately how many hours a week do you spend in your basement? 2-5 hrs

5. Are there any cans of paint, paint thinner, gasoline or other solvents being stored in your basement? If yes, please describe. on Landing towards basement

6. Have you ever noticed any odors in your basement that you could not explain by the material you have stored there or by activities in the rest of the house? If so, please describe. NO Really

7. Does your house have a crawl space? yes [✓ no]

8. If you do have a crawl space, approximately how many square feet does it cover? ____________

9. Does your household use natural gas for cooking? yes [✓ no]

10. Please indicate the type of heating system you use.

   [✓ Forced air natural gas]
   Natural gas heaters
   Electric
   Wood
   Other ____________

12. Please describe the number of first floor rooms in your house. 5
    The approximate square footage of these rooms is 650 sq FT. approx.

Building-Structure Survey

Address NE-2

Name of person completing this form

Date 2/4/92

1. Approximately how many square feet does your basement cover? 50X20

2. Please indicate the type of floor your basement has.

floor ✓ Cement w/ 2x4 sized ~~gaps~~ - open ~50' in length
____ Bare earth
walls → Cinderblock
____ Other (please describe) ____

3. Does your basement have any openings to the outside air other than the door leading to the rest of the house? [✓ yes] no If yes, please describe. windows → poorly sealed

4. Approximately how many hours a week do you spend in your basement? 0
na

5. Are there any cans of paint, paint thinner, gasoline or other solvents being stored in your basement? If yes, please describe. ~~no~~ WD-40, propane tank, pvc prime silicon rubber PVC Cement (Upstairs)

6. Have you ever noticed any odors in your basement that you could not explain by the material you have stored there or by activities in the rest of the house? If so, please describe. no

7. Does your house have a crawl space? yes [✓ no]

8. If you do have a crawl space, approximately how many square feet does it cover? ____

9. Does your household use natural gas for cooking? yes [✓ no]

10. Please indicate the type of heating system you use.

Forced air natural gas
Natural gas heaters
Electric
Wood - main floor'
Other ____

12. Please describe the number of first floor rooms in your house. 5 2 Bedroom - 12x12
1 Kitchen - 18x11
1 Living room - 15x12
1 Bath - 10x10
The approximate square footage of these rooms is ____.

Building-Structure Survey

Address NE-3

Name of person completing this form

Date 2/5/92

1. Approximately how many square feet does your basement cover? 1800

2. Please indicate the type of floor your basement has.

   ✓ Cement
   ___ Bare earth
   ___ Cinderblock
   ___ Other (please describe) All carpeted or linoleumed ~~expect~~ except for 10'x5' "boiler room". Concrete floor w/drain. Drain <1", has sta water.

3. Does your basement have any openings to the outside air other than the door leading to the rest of the house? [✓ yes] no If yes, please describe.

4. Approximately how many hours a week do you spend in your basement?
   Living Area downstairs (Split level, lower level = basement)

5. Are there any cans of paint, paint thinner, gasoline or other solvents being stored in your basement? If yes, please describe. NO

6. Have you ever noticed any odors in your basement that you could not explain by the material you have stored there or by activities in the rest of the house? If so, please describe. NO

7. Does your house have a crawl space? yes [✓ no]

8. If you do have a crawl space, approximately how many square feet does it cover? ______

9. Does your household use natural gas for cooking? yes [✓ no]

10. Please indicate the type of heating system you use.

    Forced air natural gas
    Natural gas heaters — electric hot water baseboard heat.
    Electric wood boiler not used for two-three years.
    Wood
    Other ______

12. Please describe the number of first floor rooms in your house. 8
    The approximate square footage of these rooms is 1800.

Building-Structure Survey

Address NE-4

Name of person completing this form

Date 3-11-92

1. Approximately how many square feet does your basement cover? 200 □′ + crawlspac under most of rest of home

2. Please indicate the type of floor your basement has.

X Cement walls. connecting to crawlspace)
X Bare earth
___ Cinderblock
___ Other (please describe) ___

3. Does your basement have any openings to the outside air other than the door leading to the rest of the house? [✓ yes] no If yes, please describe.
~ 1square foot grated vent

relatively well-sealed all year.

4. Approximately how many hours a week do you spend in your basement? 0

5. Are there any cans of paint, paint thinner, gasoline or other solvents being stored in your basement? If yes, please describe.
no

6. Have you ever noticed any odors in your basement that you could not explain by the material you have stored there or by activities in the rest of the house? If so, please describe.
no

7. Does your house have a crawl space? [✓ yes] no

8. If you do have a crawl space, approximately how many square feet does it cover? ~ 600 □′

9. Does your household use natural gas for cooking? yes [✓ no]

10. Please indicate the type of heating system you use.

Forced air natural gas
Natural gas heaters
[✓ Electric] baseboard heaters
Wood
Other ___

12. Please describe the number of first floor rooms in your house. 6
The approximate square footage of these rooms is 1000 square feet

Building-Structure Survey

Address NE-5

Name of person completing this form

Date 3/13/92

1. Approximately how many square feet does your basement cover? ~~120~~ 200

2. Please indicate the type of floor your basement has.

   X Cement 1/2 bare earth
   X Bare earth
   ___ Cinderblock
   ___ Other (please describe) ___

3. Does your basement have any openings to the outside air other than the door leading to the rest of the house? [✓ yes] no If yes, please describe.
   Only access is from outside; No, direct connection to the upstairs

4. Approximately how many hours a week do you spend in your basement?
   0-1 hours

5. Are there any cans of paint, paint thinner, gasoline or other solvents being stored in your basement? If yes, please describe. Yes desiel fuel in plastic jug

6. Have you ever noticed any odors in your basement that you could not explain by the material you have stored there or by activities in the rest of the house? If so, please describe. No

7. Does your house have a crawl space? [✓ yes] no
   for plumbing

8. If you do have a crawl space, approximately how many square feet does it cover? 50

9. Does your household use natural gas for cooking? yes [✓ no] Wood

10. Please indicate the type of heating system you use.

    Forced air natural gas
    Natural gas heaters
    Electric
    [✓ Wood]
    Other ___

12. Please describe the number of first floor rooms in your house. 9
    The approximate square footage of these rooms is 1800.

Building-Structure Survey

Address SE-1

Name of person completing this form

Date Feb 5 1992

1. Approximately how many square feet does your basement cover? 360

2. Please indicate the type of floor your basement has.

   - ✓ Cement BOTH
   - ✓ Bare earth
   - ____ Cinderblock
   - ____ Other (please describe) __________

3. Does your basement have any openings to the outside air other than the door leading to the rest of the house? yes [✓ no] If yes, please describe. but some smaller air gaps

4. Approximately how many hours a week do you spend in your basement? 1 hr

5. Are there any cans of paint, paint thinner, gasoline or other solvents being stored in your basement? If yes, please describe. STAIN, PAINT, VARNISH (lots)
   Household Cleaning Supplies in Kitchen

6. Have you ever noticed any odors in your basement that you could not explain by the material you have stored there or by activities in the rest of the house? If so, please describe. NO

7. Does your house have a crawl space? [✓ yes] no big one – dirt.

8. If you do have a crawl space, approximately how many square feet does it cover? 550

9. Does your household use natural gas for cooking? yes [✓ no]

10. Please indicate the type of heating system you use. GAS Floor, Some Elec

    - Forced air natural gas
    - [✓ Natural gas heaters]
    - [✓ Electric]
    - Wood
    - Other __________

12. Please describe the number of first floor rooms in your house. 2 Bedrooms
    1 BATH
    1 Kitchen
    1 Laundry Rm
    1 Liv. Room
    The approximate square footage of these rooms is 950.

NEW CARPET IN LIVING ROOM

Building-Structure Survey

Address SE-2

Name of person completing this form

Date 2, 5 '92

1. Approximately how many square feet does your basement cover? 10' x 12'

2. Please indicate the type of floor your basement has.

   X Cement Floor
   ____ Bare earth
   ____ Cinderblock
   x Other (please describe) Sandstone & Morter Walls

3. Does your basement have any openings to the outside air other than the door leading to the rest of the house? [✓ yes] no If yes, please describe.
   Window always closed

4. Approximately how many hours a week do you spend in your basement?
   ~ 15 min per month

5. Are there any cans of paint, paint thinner, gasoline or other solvents being stored in your basement? If yes, please describe.
   PAINT Stored in Basement, Household cleaners in Kitchen

6. Have you ever noticed any odors in your basement that you could not explain by the material you have stored there or by activities in the rest of the house? If so, please describe. Minor problem in past with furnace exhaust in basement

7. Does your house have a crawl space? [✓ yes] no

8. If you do have a crawl space, approximately how many square feet does it cover? 25' x 25'

9. Does your household use natural gas for cooking? yes [✓ no] (Electric)

10. Please indicate the type of heating system you use.

    [✓ Forced air natural gas]
    Natural gas heaters
    Electric
    Wood
    Other ____________

12. Please describe the number of first floor rooms in your house. 2 bdrm, Living, Kitch Washroom
    The approximate square footage of these rooms is 25' x 25'.

Building-Structure Survey

Address SE-3

Name of person completing this form

Date 2/6/92

1. Approximately how many square feet does your basement cover? 600 ~ ~~800~~ ft²

2. Please indicate the type of floor your basement has.

   ☒ Cement
   ☐ Bare earth
   ☐ Cinderblock
   ☐ Other (please describe) ____________

   majority covered w/carpeting or linoleum. concrete floor bare in sampled room in places. No floor drains.

3. Does your basement have any openings to the outside air other than the door leading to the rest of the house? [✓ yes] no If yes, please describe.
   windows in every room, do not seem to be very drafty

4. Approximately how many hours a week do you spend in your basement?
   72 hrs/week

5. Are there any cans of paint, paint thinner, gasoline or other solvents being stored in your basement? If yes, please describe. Yes small (1pint can) of paint stripper
   Several quarts of enamel paint. 1/2 qrt. can of paint thinner see back →
   old can of dusting spray.

6. Have you ever noticed any odors in your basement that you could not explain by the material you have stored there or by activities in the rest of the house? If so, please describe. No

7. Does your house have a crawl space? [✓ yes] no
   extends beneath the east 1/3 of the house.

8. If you do have a crawl space, approximately how many square feet does it cover? 250 ft²

9. Does your household use natural gas for cooking? [✓ yes] no

10. Please indicate the type of heating system you use.

    Forced air natural gas
    [✓ Natural gas heaters]
    Electric
    Wood
    Other ____________

12. Please describe the number of first floor rooms in your house. 2
    The approximate square footage of these rooms is 300-350. sq ft.

Building-Structure Survey

Address SE-4

Name of person completing this form

Date 2/4/92

1. Approximately how many square feet does your ~~basement cover~~ CRAWL SPACE? 24'x48'
No basement

2. Please indicate the type of floor your basement has.

   - walls Cement
   - X Bare earth
   - ____ Cinderblock
   - ____ Other (please describe) __________

3. Does your basement have any openings to the outside air other than the door leading to the rest of the house? [✓ yes] no If yes, please describe.
The only entrance to the crawl space is a 4'x3' entry, 3 feet below ground level on the East side of the residence. Photo 19. poorly closed - see photo ——— SEE BACK →

4. Approximately how many hours a week do you spend in your basement?
ZERO

5. Are there any cans of paint, paint thinner, gasoline or other solvents being stored in your basement? If yes, please describe.
Only 1 very old can of epoxy paint (quart can). No other materials noticed

6. Have you ever noticed any odors in your basement that you could not explain by the material you have stored there or by activities in the rest of the house? If so, please describe. Musty smell occasionaly during high water (right on river)

7. Does your house have a crawl space? [✓ yes] no

8. If you do have a crawl space, approximately how many square feet does it cover? See #1

9. Does your household use natural gas for cooking? yes [✓ no]

10. Please indicate the type of heating system you use.

    - Forced air natural gas
    - ~~Natural gas heaters~~
    - Electric
    - [✓ Wood]
    - Other __________

12. Please describe the number of first floor rooms in your house. 6
The approximate square footage of these rooms is 1200 ft².

17
28
5
136
34
476

~2-3' deep

Building-Structure Survey

Address SE-5

Name of person completing this forn

Date 2-11-92

1. Approximately how many square feet does your basement cover? ~476 (500')

2. Please indicate the type of floor your basement has.

   _____ Cement
   __✓__ Bare earth — river gravels
   _____ Cinderblock
   _____ Other (please describe) _____

3. Does your basement have any openings to the outside air other than the door leading to the rest of the house? [✓ yes] no If yes, please describe.
   gaps around pipes, 4 small "vent" holes in front of house foundation.

4. Approximately how many hours a week do you spend in your basement?

5. Are there any cans of paint, paint thinner, gasoline or other solvents being stored in your basement? If yes, please describe. O

6. Have you ever noticed any odors in your basement that you could not explain by the material you have stored there or by activities in the rest of the house? If so, please describe. NO

7. Does your house have a crawl space? yes [✓ no]

8. If you do have a crawl space, approximately how many square feet does it cover? _____ N.B. Basement = 17'x28' x ~3', may be construed as a "crawlspace"

9. Does your household use natural gas for cooking? [✓ yes] no

10. Please indicate the type of heating system you use.

    Forced air natural gas
    Natural gas heaters
    Electric — water tank.
    [✓ Wood] — stove heats house.
    Other _____

12. Please describe the number of first floor rooms in your house. 4 + pantry
    The approximate square footage of these rooms is ~600.

Building-Structure Survey

Address SE-6

Name of person completing this form

Date Feb. 11, 1992

1. Approximately how many square feet does your basement cover? ______

2. Please indicate the type of floor your basement has.

   _X_ Cement
   ____ Bare earth
   ____ Cinderblock
   ____ Other (please describe) ______

3. Does your basement have any openings to the outside air other than the door leading to the rest of the house? [✓ yes] no If yes, please describe. 2 windows

4. Approximately how many hours a week do you spend in your basement? 15 "

5. Are there any cans of paint, paint thinner, gasoline or other solvents being stored in your basement? If yes, please describe. No Many types household cleaners, including 6 oz. Can of 1,1,1-TCA Cleaning Fluid.

6. Have you ever noticed any odors in your basement that you could not explain by the material you have stored there or by activities in the rest of the house? If so, please describe. No

7. Does your house have a crawl space? [✓ yes] no

8. If you do have a crawl space, approximately how many square feet does it cover? 103 ft.²

9. Does your household use natural gas for cooking? yes [✓ no]

10. Please indicate the type of heating system you use.

   Forced air natural gas
   X Natural gas heaters
   Electric
   Wood
   Other ______

12. Please describe the number of first floor rooms in your house. 6
    The approximate square footage of these rooms is 1800 sq ft.

Building-Structure Survey

Address SE-7

Name of person completing this form

Date Feb 6th 1992

1. Approximately how many square feet does your basement cover? 500-600

2. Please indicate the type of floor your basement has.

   ✓ Cement
   ___ Bare earth
   ___ Cinderblock
   ___ Other (please describe) ________________

3. Does your basement have any openings to the outside air other than the door leading to the rest of the house? [✓ yes] no If yes, please describe. 5 windows 3 on South, 2 on West. Basement door leads to Garage.

4. Approximately how many hours a week do you spend in your basement? < 1 hr.

5. Are there any cans of paint, paint thinner, gasoline or other solvents being stored in your basement? If yes, please describe. Paints, Can Rug cleaner (capped) varnish.

6. Have you ever noticed any odors in your basement that you could not explain by the material you have stored there or by activities in the rest of the house? If so, please describe. NO

7. Does your house have a crawl space? [✓ yes] no Under front porch.

8. If you do have a crawl space, approximately how many square feet does it cover? 80-100 ft.

9. Does your household use natural gas for cooking? yes [✓ no]

10. Please indicate the type of heating system you use.

    Forced air natural gas ✓
    Natural gas heaters
    Electric
    Wood
    Other ________________

12. Please describe the number of first floor rooms in your house. 2 bd, bath. ~~3~~ kitchen, Living room
The approximate square footage of these rooms is ~600 (500-600)

Building-Structure Survey

Address SE-8

Name of person completing this fori

Date 2/4/92

1. Approximately how many square feet does your basement cover? ~120 ft^2

2. Please indicate the type of floor your basement has.

   ___ Cement
   _X_ Bare earth w gravel cover
   ___ Cinderblock
   ___ Other (please describe) ___________

N.B. Entry door goes to outside.

3. Does your basement have any openings to the outside air other than the door leading to the rest of the house? [✓ yes] no If yes, please describe.
6"x6" w/ vent opening on SE side of basement

4. Approximately how many hours a week do you spend in your basement? 0

5. Are there any cans of paint, paint thinner, gasoline or other solvents being stored in your basement? If yes, please describe.
Cans of sealants, paints (latex), varnish, by entry door.

6. Have you ever noticed any odors in your basement that you could not explain by the material you have stored there or by activities in the rest of the house? If so, please describe. NO

7. Does your house have a crawl space? [✓ yes] no

8. If you do have a crawl space, approximately how many square feet does it cover? 300-500 ft^2 (cas estimate)

9. Does your household use natural gas for cooking? ~~yes~~ [✓ no] CAS Electric stove.

10. Please indicate the type of heating system you use.

    Forced air natural gas
    Natural gas heaters – panal ray
    Electric
    Wood – stove in livingroom.
    Other ___________

12. Please describe the number of first floor rooms in your house. 2 bdrm 1 bath kitchen livingroom dining room.
The approximate square footage of these rooms is ~ 930 ft^2 (cas estimate)

Building-Structure Survey

Address SE-9

Name of person completing this form

Date 2·11·92

1. Approximately how many square feet does your basement cover? 1200

2. Please indicate the type of floor your basement has.

   - ✓ Cement ~80%
   - ✓ Bare earth ~20%
   - ___ Cinderblock
   - ___ Other (please describe) ______

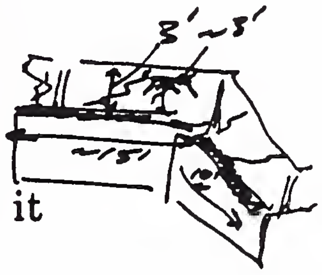
3. Does your basement have any openings to the outside air other than the door leading to the rest of the house? yes no If yes, please describe. Door leads to outside. (only opening) Basement has open well.

4. Approximately how many hours a week do you spend in your basement? <1hr

5. Are there any cans of paint, paint thinner, gasoline or other solvents being stored in your basement? If yes, please describe. Yes, many

6. Have you ever noticed any odors in your basement that you could not explain by the material you have stored there or by activities in the rest of the house? If so, please describe. NO

7. Does your house have a crawl space? [✓ yes] ~~no~~ See pictures.



8. If you do have a crawl space, approximately how many square feet does it cover? ______

9. Does your household use natural gas for cooking? yes [✓ no] electric

10. Please indicate the type of heating system you use.

    - ~~Forced~~ [✓ air natural gas]
    - Natural gas heaters
    - Electric
    - Wood
    - Other ______

12. Please describe the number of first floor rooms in your house. 4rms 1½ bath + upstai
    The approximate square footage of these rooms is 1500.

Building-Structure Survey

Address U - 1

Name of person completing this form

Date 2/12/92

1. Approximately how many square feet does your basement cover? 400 ft^2 - 350 ft^2
Bedroom ≃ 150 ft^2; furnace room 250 ft^2 - 200 ft^2

2. Please indicate the type of floor your basement has.

X Cement Bedroom is ~~[illegible]~~ carpeted
The furnace room is cement floor. w/ floor drain (drain not plumbed)
___ Bare earth
___ Cinderblock
___ Other (please describe) ______

3. Does your basement have any openings to the outside air other than the door leading to the rest of the house? [✓ yes] no If yes, please describe.
window in the storage/furnace room.

4. Approximately how many hours a week do you spend in your basement?
The son sleeps in the basement, spends 70-80 hrs/week.
The rest of the family may spend 10 hrs a week on occasion

5. Are there any cans of paint, paint thinner, gasoline or other solvents being stored in your basement? If yes, please describe.
Yes 9 gallons (partially filled) of latex paint

6. Have you ever noticed any odors in your basement that you could not explain by the material you have stored there or by activities in the rest of the house? If so, please describe. Yes, odor has been noticed for approximately 5 yrs no known source; MPC has been here to check the furnace

7. Does your house have a crawl space? [✓ yes] no

8. If you do have a crawl space, approximately how many square feet does it cover? 15 X 10' = 150 ft^2

9. Does your household use natural gas for cooking? yes [✓ no]

10. Please indicate the type of heating system you use.

[✓ Forced air natural gas]
Natural gas heaters
Electric
Wood
Other ______

12. Please describe the number of first floor rooms in your house. 6
The approximate square footage of these rooms is 1500 ft^2
50 × 30'

Completed House-Activity Forms

House-Activity Form

We are interested in recording any activity which would release solvent vapor into the air while this test is being performed. Please check off any activity which applies to your household during the sampling period. In order for your house to be sampled you must refrain from engaging in any of these activities for one day prior to the air sampling.

Residents Name BG-1

Address

Dates of Sampling 2/6/92

Painting or furniture stripping during the past week	No
Smoking	No
Deep fat frying	No
Using dry-cleaning fluid	No
Bringing dry-cleaned clothes into the house during the past week	No
Using furniture, floor, or leather polish	Occassionally
Using carpet cleaner	Seldom
Using room deodorizers	No
Using airplane glue or other glues	No Seldom
Burning wood or trash in your fireplace	No; but does have 2 Kerosen lamps upstairs
Use of gasoline, kerosine lamps, or candles	

Were any windows or doors open for extended periods prior to the sample event? yes [✓ no] opens bedroom windows most of every night.

House-Activity Form

We are interested in recording any activity which would release solvent vapor into the air while this test is being performed. Please check off any activity which applies to your household during the sampling period. In order for your house to be sampled you must refrain from engaging in any of these activities for one day prior to the air sampling.

Residents Name BG-2

Address

Dates of Sampling Feb 6 '92

Painting or furniture stripping during the past week	N
Smoking	y
Deep fat frying	y
Using dry-cleaning fluid	N
Bringing dry-cleaned clothes into the house during the past week	N
Using furniture, floor, or leather polish	N
Using carpet cleaner	N
Using room deodorizers	N
Using airplane glue or other glues	N
Burning wood or trash in your fireplace	y
Use of gasoline, kerosine lamps, or candles	N

Were any windows or doors open for extended periods prior to the sample event? [✓ yes] no Bedroom & door windows cracked open to ventilate.

NOTE: Deep Freezer Experienced Freon Leak last month.

House-Activity Form

We are interested in recording any activity which would release solvent vapor into the air while this test is being performed. Please check off any activity which applies to your household during the sampling period. In order for your house to be sampled you must refrain from engaging in any of these activities for one day prior to the air sampling.

Residents Name BG-3

Address

Dates of Sampling 2/12/92

Painting or furniture stripping during the past week	No
Smoking	No
Deep fat frying	The previous night
Using dry-cleaning fluid	No
Bringing dry-cleaned clothes into the house during the past week	No ; very seldom
Using furniture, floor, or leather polish	Dusted yesterday 2/11/92
Using carpet cleaner	No
Using room deodorizers	No occasionally
Using airplane glue or other glues	No
Burning wood or trash in your fireplace	Yes
Use of gasoline, kerosine lamps, or candles	No seldom

Were any windows or doors open for extended periods prior to the sample event? yes [✓ no]

House-Activity Form

We are interested in recording any activity which would release solvent vapor into the air while this test is being performed. Please check off any activity which applies to your household during the sampling period. In order for your house to be sampled you must refrain from engaging in any of these activities for one day prior to the air sampling.

Residents Name BG-4

Address

Dates of Sampling FEB 12 '92

Painting or furniture stripping during the past week		N	
Smoking		N	
Deep fat frying		N	
Using dry-cleaning fluid		N	
Bringing dry-cleaned clothes into the house during the past week		N	
Using furniture, floor, or leather polish	Some cleaners, polish in basement.	N	
Using carpet cleaner		N	
Using room deodorizers		Y	{ Lysol used infrequently }
Using airplane glue or other glues		N	
Burning wood or trash in your fireplace		N	
Use of ~~gasoline, kerosine lamps~~, or candles		N	

Were any windows or doors open for extended periods prior to the sample event? yes [✓ no]

House-Activity Form

We are interested in recording any activity which would release solvent vapor into the air while this test is being performed. Please check off any activity which applies to your household during the sampling period. In order for your house to be sampled you must refrain from engaging in any of these activities for one day prior to the air sampling.

Residents Name BG-5

Address

Dates of Sampling FEB 11 1992

Painting or furniture stripping during the past week	N
Smoking	N
Deep fat frying	N
Using dry-cleaning fluid	N
Bringing dry-cleaned clothes into the house during the past week	N
Using [✓ furniture], floor, or leather polish	Y
Using carpet cleaner	N
Using room deodorizers	Y
Using airplane glue or other glues	y (for crafts)
Burning wood or trash in your fireplace	N
Use of gasoline, kerosine lamps, or candles	N

Were any windows or doors open for extended periods prior to the sample event? yes [✓ no]

House-Activity Form

We are interested in recording any activity which would release solvent vapor into the air while this test is being performed. Please check off any activity which applies to your household during the sampling period. In order for your house to be sampled you must refrain from engaging in any of these activities for one day prior to the air sampling.

Residents Name NE-1

Address

Dates of Sampling 2/5/92

Painting or furniture stripping during the past week	NO
Smoking — Joe Gilliam returned at 11:50, was smoking a Camel filter.	Yes
Deep fat frying	NO
Using dry-cleaning fluid	NO
Bringing dry-cleaned clothes into the house during the past week	NO
Using furniture, floor, or leather polish	NO
Using carpet cleaner	NO
Using room deodorizers	Sometimes
Using airplane glue or other glues	NO
Burning wood or trash in your fireplace	NO
Use of gasoline, kerosine lamps, or candles	NO

Were any windows or doors open for extended periods prior to the sample event? yes [✓ no]

House-Activity Form

We are interested in recording any activity which would release solvent vapor into the air while this test is being performed. Please check off any activity which applies to your household during the sampling period. In order for your house to be sampled you must refrain from engaging in any of these activities for one day prior to the air sampling.

Residents Name NE-2

Address

Dates of Sampling 2/4/92

Painting or furniture stripping during the past week		no
Smoking	(previous day in bsmt.)	yes
Deep fat frying		no
Using dry-cleaning fluid		no
Bringing dry-cleaned clothes into the house during the past week		no
Using furniture, floor, or leather polish		no
Using carpet cleaner		no
Using room deodorizers		no
Using airplane glue or other glues		no
Burning wood or trash in your fireplace	upstairs	yes
Use of gasoline, kerosine lamps, or candles	upstairs only	yes *

Were any windows or doors open for extended periods prior to the sample event? yes [✓ no]

1 can WD-40
* propane heater stored only in bsmt.
PVC primer "

House-Activity Form

We are interested in recording any activity which would release solvent vapor into the air while this test is being performed. Please check off any activity which applies to your household during the sampling period. In order for your house to be sampled you must refrain from engaging in any of these activities for one day prior to the air sampling.

Residents Name NE-3

Address

Dates of Sampling 2/5/92

Painting or furniture stripping during the past week	NO
Smoking	NO
Deep fat frying	NO
Using dry-cleaning fluid	NO
Bringing dry-cleaned clothes into the house during the past week	1 blouse, wk ago.
Using furniture, floor, or leather polish	NO
Using carpet cleaner	NO
Using room deodorizers	NO
Using airplane glue or other glues	NO
Burning wood or trash in your fireplace	NO
Use of gasoline, kerosine lamps, or candles	NO

Were any windows or doors open for extended periods prior to the sample event? yes [✓ no]

House-Activity Form

We are interested in recording any activity which would release solvent vapor into the air while this test is being performed. Please check off any activity which applies to your household during the sampling period. In order for your house to be sampled you must refrain from engaging in any of these activities for one day prior to the air sampling.

Residents Name NE-4

Address

Dates of Sampling 3-11-92

Painting or furniture stripping during the past week	no
Smoking	no
Deep fat frying	no
Using dry-cleaning fluid	no
Bringing dry-cleaned clothes into the house during the past week	no
Using furniture, floor, or leather polish	no
Using carpet cleaner	"Resolve" carpet cleaner 1 day pre
Using room deodorizers	no
Using airplane glue or other glues	no
Burning wood or trash in your fireplace	wood in AM
Use of gasoline, kerosine lamps, or candles	no

Were any windows or doors open for extended periods prior to the sample event? yes [✓ no]

House-Activity Form

We are interested in recording any activity which would release solvent vapor into the air while this test is being performed. Please check off any activity which applies to your household during the sampling period. In order for your house to be sampled you must refrain from engaging in any of these activities for one day prior to the air sampling.

Residents Name N.E-5

Address

Dates of Sampling 3/13/92

Painting or furniture stripping during the past week	no
Smoking	yes
Deep fat frying	no
Using dry-cleaning fluid	no
Bringing dry-cleaned clothes into the house during the past week	no
Using furniture, floor, or leather polish	no
Using carpet cleaner	no
Using room deodorizers	no
Using airplane glue or other glues	no
Burning wood or trash in your fireplace	yes
Use of gasoline, kerosine lamps, or candles	no

Were any windows or doors open for extended periods prior to the sample event? yes [✓ no]

House-Activity Form

We are interested in recording any activity which would release solvent vapor into the air while this test is being performed. Please check off any activity which applies to your household during the sampling period. In order for your house to be sampled you must refrain from engaging in any of these activities for one day prior to the air sampling.

Residents Name SE-1

Address

Dates of Sampling Feb 5 1992

Painting or furniture stripping during the past week		
Smoking	✓	Both husband & wife smoke.
Deep fat frying		
Using dry-cleaning fluid		
Bringing dry-cleaned clothes into the house during the past week	✓	
Using furniture, floor, or leather polish		
Using carpet cleaner New CARPET In LIVING Room		
Using room deodorizers	✓	Glade Potpouri Cinamon Stick Spray
Using airplane glue or other glues		
Burning wood or trash in your fireplace		
Use of gasoline, kerosine lamps, or candles		

Were any windows or doors open for extended periods prior to the sample event? yes [✓ no]

(✓ = YES)

House-Activity Form

We are interested in recording any activity which would release solvent vapor into the air while this test is being performed. Please check off any activity which applies to your household during the sampling period. In order for your house to be sampled you must refrain from engaging in any of these activities for one day prior to the air sampling.

Residents Name SE-2

Address

Dates of Sampling FEB. 5 1992

Painting or furniture stripping during the past week	N
Smoking	N
Deep fat frying	Y
Using dry-cleaning fluid	N
Bringing dry-cleaned clothes into the house during the past week	N
Using furniture, floor, or leather polish	Y
Using carpet cleaner	N
Using room deodorizers	Y
Using airplane glue or other glues	N
Burning wood or trash in your fireplace	N
Use of gasoline, kerosine lamps, or candles	N

Were any windows or doors open for extended periods prior to the sample event? [✓ yes] no
Bedroom window only.

House-Activity Form

We are interested in recording any activity which would release solvent vapor into the air while this test is being performed. Please check off any activity which applies to your household during the sampling period. In order for your house to be sampled you must refrain from engaging in any of these activities for one day prior to the air sampling.

Residents Name SE-3

Address

Dates of Sampling 2/6/92

Painting or furniture stripping during the past week	No
Smoking	No
Deep fat frying	No (never)
Using dry-cleaning fluid	No
Bringing dry-cleaned clothes into the house during the past week	No
Using furniture, floor, or leather polish	No (very seldom)
Using carpet cleaner	No
Using room deodorizers	No (seldom use can in bathroom)
Using airplane glue or other glues	No
Burning wood or trash in your fireplace	No
Use of gasoline, kerosine lamps, or candles	No

Were any windows or doors open for extended periods prior to the sample event? [✓ yes] no

Opens doors upstairs once a day to let air blow through.

Opens down stairs bedroom window at night.

House-Activity Form

We are interested in recording any activity which would release solvent vapor into the air while this test is being performed. Please check off any activity which applies to your household during the sampling period. In order for your house to be sampled you must refrain from engaging in any of these activities for one day prior to the air sampling.

Residents Name SE-4

Address

Dates of Sampling 2/4/92

Painting or furniture stripping during the past week	No
Smoking	no
Deep fat frying	No - occasionall
Using dry-cleaning fluid	No #, seldom
Bringing dry-cleaned clothes into the house during the past week	No
Using furniture, floor, or leather polish	No occasional
Using carpet cleaner	No "
Using room deodorizers	~~No~~ (frequently)
Using airplane glue or other glues	No (seldom)
Burning wood or trash in your ~~fireplace~~ HEATING STOVE	Yes - Now
Use of gasoline, kerosine lamps, or candles	No

Were any windows or doors open for extended periods prior to the sample event? [✓ yes] no

House-Activity Form

We are interested in recording any activity which would release solvent vapor into the air while this test is being performed. Please check off any activity which applies to your household during the sampling period. In order for your house to be sampled you must refrain from engaging in any of these activities for one day prior to the air sampling.

Residents Name SE-5

Address

Dates of Sampling 2-11-92

Painting or furniture stripping during the past week	Urethane varnishing in upstairs (2nd floor) ~~[illegible]~~ about 2wks
Smoking	N
Deep fat frying	N
Using dry-cleaning fluid	N
Bringing dry-cleaned clothes into the house during the past week	N
Using furniture, floor, or leather polish	Endust usually on Tuesdays & Thursdays.
Using carpet cleaner	N
Using room deodorizers	N
Using airplane glue or other glues	N
Burning wood or trash in your fireplace	Wood Stove = heat source, goes almost all time.
Use of gasoline, kerosine lamps, or candles	N

Were any windows or doors open for extended periods prior to the sample event? [✓ yes] no

House-Activity Form

We are interested in recording any activity which would release solvent vapor into the air while this test is being performed. Please check off any activity which applies to your household during the sampling period. In order for your house to be sampled you must refrain from engaging in any of these activities for one day prior to the air sampling.

Residents Name SE - 6

Address

Dates of Sampling Feb. 11, 1992

Painting or furniture stripping during the past week		No
Smoking		No
Deep fat frying		No
Using dry-cleaning fluid		No
Bringing dry-cleaned clothes into the house during the past week		No
Using furniture, floor, or leather polish	[Spray Polish, Silicone, Spray [floor was stored in back hall.	No
Using carpet cleaner		No
Using room deodorizers	[Potpourri Basket in Living Room.	No
Using airplane glue or other glues		No
Burning wood or trash in your fireplace		No
Use of gasoline, kerosine lamps, or candles		No

Were any windows or doors open for extended periods prior to the sample event? yes [✓ no]

House-Activity Form

We are interested in recording any activity which would release solvent vapor into the air while this test is being performed. Please check off any activity which applies to your household during the sampling period. In order for your house to be sampled you must refrain from engaging in any of these activities for one day prior to the air sampling.

Residents Name SE-7

Address

Dates of Sampling Feb 6th 1992

Painting or furniture stripping during the past week	NO
Smoking	NO
Deep fat frying	NO
Using dry-cleaning fluid	NO
Bringing dry-cleaned clothes into the house during the past week	NO
Using furniture, floor, or leather polish	NO
Using carpet cleaner	NO
Using room deodorizers	NO
Using airplane glue or other glues	NO
Burning wood or trash in your fireplace	NO
Use of gasoline, kerosine lamps, or candles	NO

Were any windows or doors open for extended periods prior to the sample event? yes [✓ no]

House-Activity Form

We are interested in recording any activity which would release solvent vapor into the air while this test is being performed. Please check off any activity which applies to your household during the sampling period. In order for your house to be sampled you must refrain from engaging in any of these activities for one day prior to the air sampling.

Residents Name SE-8

Address

Dates of Sampling 2-4-92

Painting or furniture stripping during the past week	NO
Smoking	YES
Deep fat frying	NO
Using dry-cleaning fluid	NO
Bringing dry-cleaned clothes into the house during the past week	NO
Using furniture, floor, or leather polish	NO
Using carpet cleaner	NO
Using room deodorizers	NO
Using airplane glue or other glues	NO
Burning wood or trash in your fireplace	YES
Use of gasoline, kerosine lamps, or candles	NO

Were any windows or doors open for extended periods prior to the sample event? yes [✓ no]

House-Activity Form

We are interested in recording any activity which would release solvent vapor into the air while this test is being performed. Please check off any activity which applies to your household during the sampling period. In order for your house to be sampled you must refrain from engaging in any of these activities for one day prior to the air sampling.

Residents Name SE-9

Address

Dates of Sampling 2·11·92

House was empty for 2 weeks until last Friday (2.7.92)

Painting or furniture stripping during the past week		N
Smoking	lots	Y
Deep fat frying		N
Using dry-cleaning fluid		N
Bringing dry-cleaned clothes into the house during the past week		N
Using furniture, floor, or leather polish		N
Using carpet cleaner		N
Using room deodorizers		N
Using airplane glue or other glues		N
Burning wood or trash in your fireplace		wood fires each evening
Use of gasoline, kerosine lamps, or candles		N

Were any windows or doors open for extended periods prior to the sample event? yes no

↳ Sunday – doors open to air out the house

House-Activity Form

We are interested in recording any activity which would release solvent vapor into the air while this test is being performed. Please check off any activity which applies to your household during the sampling period. In order for your house to be sampled you must refrain from engaging in any of these activities for one day prior to the air sampling.

Residents Name U-1

Address

Dates of Sampling 2/12/92

Painting or furniture stripping during the past week	No
Smoking	No
Deep fat frying	No (never)
Using dry-cleaning fluid	No
Bringing dry-cleaned clothes into the house during the past week	No (never)
Using furniture, floor, or leather polish	furniture Polish occassionally
Using carpet cleaner	No
Using room deodorizers	Yes
Using airplane glue or other glues	No (seldom)
Burning wood or trash in your fireplace	No Fireplace
Use of gasoline, kerosine lamps, or candles	No

Were any windows or doors open for extended periods prior to the sample event? yes [✓ no]

Appendix B

Analytical Results

Berkeley Analytical Associates

Field Sample Analytical Results for Tetrachloroethene, Trichloroethene, and the 1,2-Dichloroethene Isomers

NARRATIVE REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001
Report Date: February 23, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative

Report Approved By: Hodgson

QUANTITATIVE GC-MS ANALYSIS OF TRANS-1,2-DICHLOROETHENE, CIS-1,2-DICHLOROETHENE, TRICHLOROETHENE, AND TETRACHLOROETHENE

Methods

The samples were collected on multisorbent samplers (Model number ST-032, Envirochem, Inc.) which contain Tenax-TA, Carboxen carbon molecular sieve and activated charcoal in series. These samplers have been validated for the collection of air toxic compounds (Broelher *et al.*, 1990, attached).

The compounds, *trans*-1,2-dichloroethene, *cis*-1,2-dichloroethene, trichloroethene, and tetrachloroethene, were obtained from Aldrich Chemical Company, Inc. for the preparation of analytical standards. Gas standards were prepared using the EPA static dilution bottle method. At the beginning and again near the end of the project, multi-point calibrations were run for all four compounds. On each day of analysis, at least one calibration standard and one system blank were analyzed.

The samplers were analyzed for the study compounds by thermal desorption-gas chromatography-mass spectrometry. The thermal desorption-sample concentrator unit is a UNACON Series 810 (Envirochem, Inc.) The mass spectrometer was operated in the selected-ion monitoring (SIM) mode to maximize the selectivity and sensitivity of the analysis for the study compounds.

The quality assurance program used for the analysis for volatile organic compounds is described in the document, BAA-SOP-92.01 (attached). Standard operating procedures describe all aspects of sampler conditioning, storage and analysis.

Results

Reasonable limits of quantitation for all four compounds were estimated to be 0.5 ng, or about 0.2 ug m^{-3} for a three-liter sample. Eight system blanks were

analyzed during the project. The masses of the study compounds in these blanks were all less than the limit of quantitation with the exception of one blank in which the mass of tetrachloroethene was 1.7 ng. Forty-nine field samples were analyzed. Concentrations of the study compounds in ug m-3 were calculated using the sample volumes reported in standard liters. A separate report was prepared for each system blank and field sample. These are shown in the following list of reports.

NARRATIVE REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06002
Report Date: March 21, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative

Report Approved By:

QUANTITATIVE GC-MS ANALYSIS OF TRANS-1,2-DICHLOROETHENE, CIS-1,2-DICHLOROETHENE, TRICHLOROETHENE, AND TETRACHLOROETHENE

Methods

The samples were collected on multisorbent samplers (Model number ST-032, Envirochem, Inc.) which contain Tenax-TA, Carboxen carbon molecular sieve and activated charcoal, in series. These samplers have been validated for the collection of air toxic compounds (Broehler *et al.*, 1990).

The target compounds, *trans*-1,2-dichloroethene, *cis*-1,2-dichloroethene, trichloroethene, and tetrachloroethene, were obtained from Aldrich Chemical Company, Inc. for the preparation of analytical standards. Gas standards were prepared using the U.S. EPA static dilution bottle method. Twice during the analysis period for the samples reported here, multi-point calibrations were run for all four compounds. On each day of analysis, at least one calibration standard and one system blank were analyzed.

The samplers were analyzed for the four target compounds by thermal desorption-gas chromatography-mass spectrometry. The thermal desorption-sample concentrator unit is a UNACON Series 810 (Envirochem, Inc.) The mass spectrometer was operated in the selected-ion monitoring (SIM) mode to maximize the selectivity and sensitivity of the analysis for the study compounds.

All of the samplers were simultaneously analyzed for total volatile organic compounds (TVOC) using the UNACON concentrator, which has a built-in flame ionization detector (FID). During the thermal desorption of each sampler, a controlled portion of each sample (eight percent) was automatically split off prior to GC separation and sent directly to the FID. A single peak was produced. The area of this peak was calibrated using a mixture of C_6-C_{12} normal-alkane hydrocarbons. The mass of carbon contributed to this mixture by each compound was approximately equal. The results of the TVOC analysis are best expressed as mass of carbon since this is what the FID detects. Carbon masses can be converted

to equivalent masses of other compounds, such as hexane and toluene. Because there is some variation in the per-carbon response of different classes of compounds, the measurement of TVOC is inherently less accurate than the calibrated measurement of individual VOC.

The quality assurance program used for the analysis for volatile organic compounds is described in the document, BAA-SOP-92.01. Standard operating procedures describe all aspects of sampler conditioning, storage and analysis.

Results

Reasonable limits of quantitation for all four target compounds were estimated to be 0.5 ng, or about 0.2 ug m^{-3} for a three-liter sample. Four system blanks were analyzed during the analysis period. The masses of the target compounds in these blanks were all less than the reported limit of quantitation. Nineteen field samples were analyzed. Of these, four were field blanks. Blank sampler 031-S contained 0.7 ng of *cis*-1,2-dichloroethene and 0.8 ng of tetrachloroethene. Sampler 026-S contained 0.9 ng tetrachloroethene. The presence of detectable amounts of tetrachloroethene in these field blanks may possibly be explained by diffusive sampling by the multisorbent samplers during the periods in which they were left uncapped.

Concentrations of the target compounds in the field samples (ug m^{-3}) were calculated using the sample volumes reported in standard liters. The quantitative results for the target compounds in the system blanks, the field blanks and the field samples are presented in the MASS reports listed in the attached table.

Difficulties were encountered during the analysis of Sampler 024-S (no results were obtained or reported) and Sampler 025-S. These difficulties were attributed to the presence of excess water in the samples which resulted in a shutdown of the mass spectrometer during the analysis. All data for Sampler 024-S were lost. It was possible to restart the mass spectrometer during the analysis of Sampler 025-S. No meaningful retention-time data were obtained. However, since the method additionally uses the ratio of two unique masses to identify the compounds, the trichloroethene and tetrachloroethene peaks were positively identified. No data were obtained for the isomers of 1,2-dichloroethene since these eluted during the period in which the mass spectrometer was off. The Trichloroethene and tetrachloroethene data for Sampler 025-S are considered to be quantitative.

The results of the TVOC analyses of the soil-gas samples are presented in report TVOC037. The masses of carbon were multiplied by 1.196 to produce hexane-equivalent masses. The sample masses were not corrected for the masses in the two field blanks which were 29 and 96 ng carbon.

MASS063, 2/16/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 16, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 001-N
Sampler Received: February 14, 1992
Sampler Analyzed: February 16, 1992
GC-MS Data File: 02162_04
Reported Sample Volume: 3.15 std L
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 001-N.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	ND	<0.5	<0.16
cis-1,2-Dichloroethene	22.90	<0.5	<0.16
Trichloroethene	26.00	7.4	2.35
Tetrachloroethene	29.90	136	43.2

Comments: ND = Not detected. The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS088, 3/17/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06002

Report Date: March 17, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 003-S
Sampler Received: March 14, 1992
Sampler Analyzed: March 16, 1992
GC-MS Data File: 03162_08
Reported Sample Volume: 3.07
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 003-S.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.46	<0.5	<0.16
cis-1,2-Dichloroethene	22.85	0.8	0.26
Trichloroethene	25.99	4.6	1.50
Tetrachloroethene	29.92	252	82.1

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 9, 1992, Revised February 12, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 005
Sampler Received: February 7, 1992
Sampler Analyzed: February 8, 1992
GC-MS Data File: 02082_06
Reported Sample Volume: 2.69 std L
Analyst: Al Hodgson

Report Approved By: Hodgson

Quantitative Analysis of Sampler 005.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-dichloroethene	19.49	<0.5	<0.19
cis-1,2-dichloroethene	22.89	<0.5	<0.19
Trichloroethene	26.02	1.2	0.45
Tetrachloroethene	29.92	50.8	18.9

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06002

Report Date: March 19, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 009-S
Sampler Received: March 14, 1992
Sampler Analyzed: March 19, 1992
GC-MS Data File: 03192_09
Reported Sample Volume: 2.54 std. L
Analyst: Al Hodgson

Report Approved By: Hodgson

Quantitative Analysis of Sampler 009-S.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.49	1.0	0.39
cis-1,2-Dichloroethene	22.87	1.6	0.63
Trichloroethene	26.00	3.3	1.30
Tetrachloroethene	29.89	15.7	6.18

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS058, 2/16/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 16, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 010
Sampler Received: February 14, 1992
Sampler Analyzed: February 15, 1992
GC-MS Data File: 02152_07
Reported Sample Volume: 2.85 std L
Analyst: Raja Tannous

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 010.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.50	<0.5	<0.18
cis-1,2-Dichloroethene	22.88	<0.5	<0.18
Trichloroethene	26.00	<0.5	<0.18
Tetrachloroethene	29.90	3.8	1.33

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 9, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 014
Sampler Received: February 8, 1992
Sampler Analyzed: February 9, 1992
GC-MS Data File: 02092_10
Reported Sample Volume: 2.12 std L
Analyst: Al Hodgson

Report Approved By: Hodgson

Quantitative Analysis of Sampler 014.

Compound	RT (min)	Mass (ng)	Conc. ug m^{-3})
trans-1,2-Dichloroethene	19.53	<0.5	<0.24
cis-1,2-Dichloroethene	22.91	<0.5	<0.24
Trichloroethene	26.05	<0.5	<0.24
Tetrachloroethene	29.96	2.6	1.23

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS082, 2/21/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 21, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 014-N
Sampler Received: February 15, 1992
Sampler Analyzed: February 20, 1992
GC-MS Data File: 02202_11
Reported Sample Volume: 2.62 std L
Analyst: Al Hodgson

Report Approved By: A S Hodgson

Quantitative Analysis of Sampler 014-N.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.49	<0.5	<0.19
cis-1,2-Dichloroethene	22.87	0.7	0.27
Trichloroethene	26.00	0.8	0.31
Tetrachloroethene	29.90	18.0	6.87

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS068 Revised, 2/17/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 16, 1992; Revised February 17, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 015-N
Sampler Received: February 15, 1992
Sampler Analyzed: February 16, 1992
GC-MS Data File: 02162_09
Reported Sample Volume: 2.92 std L
Analyst: Raja Tannous

Report Approved By: A J Hodgson

Quantitative Analysis of Sampler 015-N.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.47	<0.5	<0.17
cis-1,2-Dichloroethene	22.86	<0.5	<0.17
Trichloroethene	25.99	<0.5	<0.17
Tetrachloroethene	29.89	6.4	2.19

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS104, 3/20/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06002

Report Date: March 20, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 017-S
Sampler Received: March 14, 1992
Sampler Analyzed: March 19, 1992
GC-MS Data File: 03192_12
Reported Sample Volume: 0.09 std. L
Analyst: Raja Tannous

Report Approved By: ____________________

Quantitative Analysis of Sampler 017-S.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.46	<0.5	<5.56
cis-1,2-Dichloroethene	22.85	<0.5	<5.56
Trichloroethene	25.98	<0.5	<5.56
Tetrachloroethene	29.88	<0.5	<5.56

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS039, 2/9/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 9, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 019
Sampler Received: February 8, 1992
Sampler Analyzed: February 9, 1992
GC-MS Data File: 02092_09
Reported Sample Volume: 2.80 std L
Analyst: Al Hodgson

Report Approved By: Hodgson

Quantitative Analysis of Sampler 019.

Compound	RT (min)	Mass (ng)	Conc. ug m^{-3}
trans-1,2-Dichloroethene	19.53	<0.5	<0.18
cis-1,2-Dichloroethene	22.91	<0.5	<0.18
Trichloroethene	26.05	0.6	0.21
Tetrachloroethene	29.96	3.1	1.11

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06002

Report Date: March 17, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 020-S
Sampler Received: March 14, 1992
Sampler Analyzed: March 16, 1992
GC-MS Data File: 03162_12
Reported Sample Volume: 3.16
Analyst: Al Hodgson

Report Approved By: Hodgson

Quantitative Analysis of Sampler 020-S.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.46	<0.5	<0.16
cis-1,2-Dichloroethene	22.83	<0.5	<0.16
Trichloroethene	25.97	1.8	0.57
Tetrachloroethene	29.87	17.9	5.66

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS075, 2/17/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 17, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 021-N
Sampler Received: February 15, 1992
Sampler Analyzed: February 17, 1992
GC-MS Data File: 02172_05
Reported Sample Volume: 2.23 std L
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 021-N.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.47	<0.5	<0.22
cis-1,2-Dichloroethene	22.85	<0.5	<0.22
Trichloroethene	25.99	<0.5	<0.22
Tetrachloroethene	29.89	3.4	1.52

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS095, 3/17/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06002

Report Date: March 17, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 025-S
Sampler Received: March 14, 1992
Sampler Analyzed: March 17, 1992
GC-MS Data File: 03172_08
Reported Sample Volume: 2.48
Analyst: Al Hodgson

Report Approved By: Hodgson

Quantitative Analysis of Sampler 025-S.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	ND*	ND	ND
cis-1,2-Dichloroethene	ND	ND	ND
Trichloroethene	ND	1.2	0.48
Tetrachloroethene	ND	45.5	18.4

Comments: *ND = No data. This sampler contained excess water which resulted in a temporary shutdown of the mass spectrometer. As a result, all retention time data were lost and no quantitative data were obtained for the isomers of 1,2-dichloroethene. The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS057, 2/16/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 16, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 026
Sampler Received: February 14, 1992
Sampler Analyzed: February 15, 1992
GC-MS Data File: 02152_06
Reported Sample Volume: 2.76 std L
Analyst: Raja Tannous

Report Approved By: R J Hodgson

Quantitative Analysis of Sampler 026.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.50	<0.5	<0.18
cis-1,2-Dichloroethene	22.87	<0.5	<0.18
Trichloroethene	26.01	0.6	0.22
Tetrachloroethene	29.91	4.5	1.63

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS037 Revised, 2/12/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 10, 1992, Revised February 12, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 029
Sampler Received: February 8, 1992
Sampler Analyzed: February 9, 1992
GC-MS Data File: 02092_07
Reported Sample Volume: 3.09 std L
Analyst: Raja Tannous

Report Approved By: R S Hodgson

Quantitative Analysis of Sampler 029.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-dichloroethene	19.50	<0.5	<0.16
cis-1,2-dichloroethene	22.88	<0.5	<0.16
Trichloroethene	26.02	1.1	0.36
Tetrachloroethene	29.92	4.2	1.36

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS081, 2/21/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 21, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 030-N
Sampler Received: February 14, 1992
Sampler Analyzed: February 20, 1992
GC-MS Data File: 02202_10
Reported Sample Volume: 2.14 std L
Analyst: Al Hodgson

Report Approved By: Hodgson

Quantitative Analysis of Sampler 030-N.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.48	<0.5	<0.23
cis-1,2-Dichloroethene	22.89	<0.5	<0.23
Trichloroethene	26.00	3.1	1.45
Tetrachloroethene	29.84	110	51.4

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 16, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 032
Sampler Received: February 14, 1992
Sampler Analyzed: February 15, 1992
GC-MS Data File: 02152_04
Reported Sample Volume: 2.87 std L
Analyst: Raja Tannous

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 032.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.50	<0.5	<0.17
cis-1,2-Dichloroethene	22.87	<0.5	<0.17
Trichloroethene	25.99	3.2	1.11
Tetrachloroethene	29.89	1.6	0.56

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS033, 2/9/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 9, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 035
Sampler Received: February 7, 1992
Sampler Analyzed: February 9, 1992
GC-MS Data File: 02092_03
Reported Sample Volume: 2.73 std L
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 035.

Compound	RT (min)	Mass (ng)	Conc. ug m^{-3}
trans-1,2-dichloroethene	19.50	0.6	0.22
cis-1,2-dichloroethene	22.89	0.6	0.22
Trichloroethene	26.02	0.8	0.29
Tetrachloroethene	29.92	5.0	1.83

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS094, 3/17/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06002

Report Date: March 17, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 037-S
Sampler Received: March 14, 1992
Sampler Analyzed: March 17, 1992
GC-MS Data File: 03172_03
Reported Sample Volume: 3.29
Analyst: Raja Tannous

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 037-S.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.45	<0.5	<0.15
cis-1,2-Dichloroethene	22.83	<0.5	<0.15
Trichloroethene	25.97	<0.5	<0.15
Tetrachloroethene	29.87	3.8	1.16

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 16, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 038-N
Sampler Received: February 14, 1992
Sampler Analyzed: February 16, 1992
GC-MS Data File: 02162_03
Reported Sample Volume: 2.85 std L
Analyst: Al Hodgson

Report Approved By: A J Hodgson

Quantitative Analysis of Sampler 038-N.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.47	<0.5	<0.18
cis-1,2-Dichloroethene	22.85	<0.5	<0.18
Trichloroethene	26.00	<0.5	<0.18
Tetrachloroethene	29.89	4.0	1.40

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS065, 2/16/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 16, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 041-N
Sampler Received: February 14, 1992
Sampler Analyzed: February 16, 1992
GC-MS Data File: 02162_06
Reported Sample Volume: 3.15 std L
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 041-N.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.48	<0.5	<0.16
cis-1,2-Dichloroethene	22.90	<0.5	<0.16
Trichloroethene	26.00	0.8	0.25
Tetrachloroethene	29.90	6.1	1.94

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS028 Revised, 2/12/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 9, 1992, Revised February 12, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 043
Sampler Received: February 7, 1992
Sampler Analyzed: February 8, 1992
GC-MS Data File: 02082_07
Reported Sample Volume: 2.48 std L
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 043.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.50	<0.5	<0.20
cis-1,2-Dichloroethene	22.88	<0.5	<0.20
Trichloroethene	26.02	0.6	0.24
Tetrachloroethene	29.92	14.2	5.73

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS073, 2/17/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 17, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 043-N
Sampler Received: February 15, 1992
Sampler Analyzed: February 17, 1992
GC-MS Data File: 02172_03
Reported Sample Volume: 3.02 std L
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 043-N.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.47	<0.5	<0.17
cis-1,2-Dichloroethene	22.85	1.2	0.40
Trichloroethene	25.99	4.3	1.42
Tetrachloroethene	29.90	212	70.2

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS056, 2/16/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 16, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 047
Sampler Received: February 14, 1992
Sampler Analyzed: February 15, 1992
GC-MS Data File: 02152_05
Reported Sample Volume: 2.72 std L
Analyst: Al Hodgson

Report Approved By: Hodgson

Quantitative Analysis of Sampler 047.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.49	<0.5	<0.18
cis-1,2-Dichloroethene	22.88	<0.5	<0.18
Trichloroethene	26.01	0.6	0.22
Tetrachloroethene	29.91	3.8	1.40

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 16, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 050
Sampler Received: February 14, 1992
Sampler Analyzed: February 15, 1992
GC-MS Data File: 02152_03
Reported Sample Volume: 2.95 std L
Analyst: Raja Tannous

Report Approved By: R J Hodgson

Quantitative Analysis of Sampler 050.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.41	<0.5	<0.17
cis-1,2-Dichloroethene	22.80	<0.5	<0.17
Trichloroethene	25.93	8.0	2.71
Tetrachloroethene	29.83	1.8	0.61

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06002

Report Date: March 17, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 050-S
Sampler Received: March 14, 1992
Sampler Analyzed: March 16, 1992
GC-MS Data File: 03162_11
Reported Sample Volume: 3.07
Analyst: Al Hodgson

Report Approved By: ______________

Quantitative Analysis of Sampler 050-S.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.45	<0.5	<0.16
cis-1,2-Dichloroethene	22.84	<0.5	<0.16
Trichloroethene	25.97	0.7	0.23
Tetrachloroethene	29.87	3.3	1.07

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS029, 2/9/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 9, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 051
Sampler Received: February 7, 1992
Sampler Analyzed: February 8, 1992
GC-MS Data File: 02082_08
Reported Sample Volume: 2.63 std L
Analyst: Al Hodgson

Report Approved By: Hodgson

Quantitative Analysis of Sampler 051.

Compound	RT (min)	Mass (ng)	Conc. ug m^{-3}
trans-1,2-dichloroethene	19.49	<0.5	<0.19
cis-1,2-dichloroethene	22.88	<0.5	<0.19
Trichloroethene	26.01	5.2	1.98
Tetrachloroethene	29.91	22.5	8.56

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS046, 2/12/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 12, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 052
Sampler Received: February 8, 1992
Sampler Analyzed: February 12, 1992
GC-MS Data File: 02122_09
Reported Sample Volume: 2.73 std L
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 052.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.52	<0.5	<0.18
cis-1,2-Dichloroethene	22.90	<0.5	<0.18
Trichloroethene	26.04	<0.5	<0.18
Tetrachloroethene	29.94	3.9	1.43

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS036, 2/9/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 9, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 058
Sampler Received: February 7, 1992
Sampler Analyzed: February 9, 1992
GC-MS Data File: 02092_06
Reported Sample Volume: 2.71 std L
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 058.

Compound	RT (min)	Mass (ng)	Conc. ug m^{-3}
trans-1,2-dichloroethene	19.51	<0.5	<0.18
cis-1,2-dichloroethene	22.89	<0.5	<0.18
Trichloroethene	26.02	4.4	1.62
Tetrachloroethene	29.92	10.4	3.84

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS069 Revised, 2/17/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 16, 1992; Revised February 17, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 058-N
Sampler Received: February 15, 1992
Sampler Analyzed: February 16, 1992
GC-MS Data File: 02162_10
Reported Sample Volume: 2.68 std L
Analyst: Al Hodgson

Report Approved By: Hodgson

Quantitative Analysis of Sampler 058-N.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.49	<0.5	<0.19
cis-1,2-Dichloroethene	22.88	0.7	0.26
Trichloroethene	26.01	0.8	0.30
Tetrachloroethene	29.92	16.9	6.31

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS034, 2/9/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 9, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 061
Sampler Received: February 7, 1992
Sampler Analyzed: February 9, 1992
GC-MS Data File: 02092_04
Reported Sample Volume: 2.64 std L
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 061.

Compound	RT (min)	Mass (ng)	Conc. ug m^{-3}
trans-1,2-dichloroethene	19.52	<0.5	<0.19
cis-1,2-dichloroethene	22.89	0.6	0.23
Trichloroethene	26.03	1.3	0.49
Tetrachloroethene	29.94	2.7	1.02

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS090, 3/17/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06002

Report Date: March 17, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 061-S
Sampler Received: March 14, 1992
Sampler Analyzed: March 16, 1992
GC-MS Data File: 03162_10
Reported Sample Volume: 2.43
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 061-S.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.46	<0.5	<0.21
cis-1,2-Dichloroethene	22.84	<0.5	<0.21
Trichloroethene	25.97	<0.5	<0.21
Tetrachloroethene	29.88	1.4	0.58

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 12, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 064
Sampler Received: February 8, 1992
Sampler Analyzed: February 12, 1992
GC-MS Data File: 02122_07
Reported Sample Volume: 2.61 std L
Analyst: Al Hodgson

Report Approved By: A J Hodgson

Quantitative Analysis of Sampler 064.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.50	<0.5	<0.19
cis-1,2-Dichloroethene	22.89	<0.5	<0.19
Trichloroethene	26.03	<0.5	<0.19
Tetrachloroethene	29.93	3.1	1.19

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06002

Report Date: March 19, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 065-S
Sampler Received: March 14, 1992
Sampler Analyzed: March 19, 1992
GC-MS Data File: 03192_08
Reported Sample Volume: 2.96 std. L
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 065-S.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.45	<0.5	<0.17
cis-1,2-Dichloroethene	22.84	<0.5	<0.17
Trichloroethene	25.97	1.8	0.61
Tetrachloroethene	29.87	78.5	26.5

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 12, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 066
Sampler Received: February 8, 1992
Sampler Analyzed: February 12, 1992
GC-MS Data File: 02122_08
Reported Sample Volume: 2.73 std L
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 066.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.52	<0.5	<0.18
cis-1,2-Dichloroethene	22.89	<0.5	<0.18
Trichloroethene	26.03	0.6	0.22
Tetrachloroethene	29.93	3.8	1.39

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 12, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 067
Sampler Received: February 7, 1992
Sampler Analyzed: February 12, 1992
GC-MS Data File: 02122_10
Reported Sample Volume: 1.62 std L
Analyst: Al Hodgson

Report Approved By: Al G. Hodgson

Quantitative Analysis of Sampler 067.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.52	<0.5	<0.31
cis-1,2-Dichloroethene	22.90	<0.5	<0.31
Trichloroethene	26.03	0.8	0.49
Tetrachloroethene	29.93	1.5	0.93

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06002

Report Date: March 19, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 069-S
Sampler Received: March 14, 1992
Sampler Analyzed: March 19, 1992
GC-MS Data File: 03192_10
Reported Sample Volume: 0.09 std. L
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 069-S.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.46	<0.5	<5.56
cis-1,2-Dichloroethene	22.85	<0.5	<5.56
Trichloroethene	25.99	<0.5	<5.56
Tetrachloroethene	29.89	0.5	5.56

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 16, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 079-N
Sampler Received: February 14, 1992
Sampler Analyzed: February 15, 1992
GC-MS Data File: 02152_12
Reported Sample Volume: 3.31 std L
Analyst: Al Hodgson

Report Approved By: ____________________

Quantitative Analysis of Sampler 079-N.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.46	<0.5	<0.15
cis-1,2-Dichloroethene	22.85	<0.5	<0.15
Trichloroethene	25.98	0.5	0.15
Tetrachloroethene	29.88	6.4	1.93

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06002

Report Date: March 19, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 080-S
Sampler Received: March 14, 1992
Sampler Analyzed: March 19, 1992
GC-MS Data File: 03192_11
Reported Sample Volume: 0.66 std. L
Analyst: Al Hodgson

Report Approved By: Hodgson

Quantitative Analysis of Sampler 080-S.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.47	<0.5	<0.76
cis-1,2-Dichloroethene	22.85	<0.5	<0.76
Trichloroethene	25.99	6.3	9.55
Tetrachloroethene	29.89	6.0	9.09

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 9, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 082
Sampler Received: February 8, 1992
Sampler Analyzed: February 9, 1992
GC-MS Data File: 02092_08
Reported Sample Volume: 2.64 std L
Analyst: Raja Tannous

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 082.

Compound	RT (min)	Mass (ng)	Conc. ug m^{-3}
trans-1,2-Dichloroethene	19.53	<0.5	<0.19
cis-1,2-Dichloroethene	22.91	<0.5	<0.19
Trichloroethene	26.05	2.8	1.06
Tetrachloroethene	29.95	3.8	1.44

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS070 Revised, 2/17/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 16, 1992; Revised February 17, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 082-N
Sampler Received: February 15, 1992
Sampler Analyzed: February 16, 1992
GC-MS Data File: 02162_11
Reported Sample Volume: 2.67 std L
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 082-N.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.48	<0.5	<0.19
cis-1,2-Dichloroethene	22.85	0.7	0.26
Trichloroethene	25.99	0.8	0.30
Tetrachloroethene	29.90	14.6	5.47

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 9, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 083
Sampler Received: February 7, 1992
Sampler Analyzed: February 8, 1992
GC-MS Data File: 02082_09
Reported Sample Volume: 2.67 std L
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 083.

Compound	RT (min)	Mass (ng)	Conc. ug m^{-3}
trans-1,2-dichloroethene	19.51	<0.5	<0.19
cis-1,2-dichloroethene	22.88	<0.5	<0.19
Trichloroethene	26.02	8.9	3.33
Tetrachloroethene	29.92	36.5	13.7

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS035, 2/9/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 9, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 085
Sampler Received: February 7, 1992
Sampler Analyzed: February 9, 1992
GC-MS Data File: 02092_05
Reported Sample Volume: 2.91 std L
Analyst: Al Hodgson

Report Approved By: Hodgson

Quantitative Analysis of Sampler 085.

Compound	RT (min)	Mass (ng)	Conc. ug m^{-3}
trans-1,2-dichloroethene	19.53	<0.5	<0.17
cis-1,2-dichloroethene	22.91	0.7	0.24
Trichloroethene	26.05	3.1	1.07
Tetrachloroethene	29.96	187	64.3

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS048, 2/12/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 12, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 089
Sampler Received: February 7, 1992
Sampler Analyzed: February 12, 1992
GC-MS Data File: 02122_11
Reported Sample Volume: 2.62 std L
Analyst: Al Hodgson

Report Approved By: Hodgson

Quantitative Analysis of Sampler 089.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.51	<0.5	<0.19
cis-1,2-Dichloroethene	22.89	<0.5	<0.19
Trichloroethene	26.03	0.8	0.31
Tetrachloroethene	29.93	45.2	17.2

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 12, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 090
Sampler Received: February 8, 1992
Sampler Analyzed: February 12, 1992
GC-MS Data File: 02122_06
Reported Sample Volume: 2.69 std L
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 090.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.51	<0.5	<0.19
cis-1,2-Dichloroethene	22.89	<0.5	<0.19
Trichloroethene	26.03	<0.5	<0.19
Tetrachloroethene	29.93	3.0	1.12

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS032 Revised, 2/12/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 9, 1992, Revised February 12, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 093
Sampler Received: February 7, 1992
Sampler Analyzed: February 8, 1992
GC-MS Data File: 02082_11
Reported Sample Volume: 2.48 std L
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 093.

Compound	RT (min)	Mass (ng)	Conc. ($\mathrm{ug\ m^{-3}}$)
trans-1,2-dichloroethene	19.51	<0.5	<0.20
cis-1,2-dichloroethene	22.88	<0.5	<0.20
Trichloroethene	26.02	1.9	0.77
Tetrachloroethene	29.92	67.0	27.0

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 16, 1992; Revised February 17, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 094-N
Sampler Received: February 15, 1992
Sampler Analyzed: February 16, 1992
GC-MS Data File: 02162_08
Reported Sample Volume: 2.81 std L
Analyst: Raja Tannous

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 094-N.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.47	<0.5	<0.18
cis-1,2-Dichloroethene	22.86	<0.5	<0.18
Trichloroethene	25.99	4.8	1.71
Tetrachloroethene	29.89	14.6	5.20

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 12, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 096
Sampler Received: February 7, 1992
Sampler Analyzed: February 12, 1992
GC-MS Data File: 02122_13
Reported Sample Volume: 2.96 std L
Analyst: Al Hodgson

Report Approved By: Hodgson

Quantitative Analysis of Sampler 096.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.51	<0.5	<0.17
cis-1,2-Dichloroethene	22.90	<0.5	<0.17
Trichloroethene	26.03	<0.5	<0.17
Tetrachloroethene	29.93	4.6	1.55

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS049, 2/12/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 12, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 102
Sampler Received: February 7, 1992
Sampler Analyzed: February 12, 1992
GC-MS Data File: 02122_12
Reported Sample Volume: 1.90 std L
Analyst: Al Hodgson

Report Approved By: Hodgson

Quantitative Analysis of Sampler 102.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.49	<0.5	<0.26
cis-1,2-Dichloroethene	22.88	<0.5	<0.26
Trichloroethene	26.02	1.3	0.68
Tetrachloroethene	29.93	46.7	24.6

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS031, 2/9/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 9, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 104
Sampler Received: February 7, 1992
Sampler Analyzed: February 8, 1992
GC-MS Data File: 02082_10
Reported Sample Volume: 2.69 std L
Analyst: Al Hodgson

Report Approved By: Hodgson

Quantitative Analysis of Sampler 104.

Compound	RT (min)	Mass (ng)	Conc. ug m^{-3}
trans-1,2-dichloroethene	19.50	<0.5	<0.19
cis-1,2-dichloroethene	22.89	<0.5	<0.19
Trichloroethene	26.02	<0.5	<0.19
Tetrachloroethene	29.92	9.0	3.35

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06002

Report Date: March 19, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 106-V
Sampler Received: March 14, 1992
Sampler Analyzed: March 19, 1992
GC-MS Data File: 03192_15
Reported Sample Volume: 1.28 std. L
Analyst: Raja Tannous

Report Approved By: ____________________

Quantitative Analysis of Sampler 106-V.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.46	<0.5	<0.39
cis-1,2-Dichloroethene	22.84	<0.5	<0.39
Trichloroethene	25.98	6.4	5.00
Tetrachloroethene	29.88	18.4	14.4

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS110, 3/21/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06002

Report Date: March 21, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 114-V
Sampler Received: March 14, 1992
Sampler Analyzed: March 21, 1992
GC-MS Data File: 03212_03
Reported Sample Volume: 1.32 std. L
Analyst: Al Hodgson

Report Approved By: AJ Hodgson

Quantitative Analysis of Sampler 114-V.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.51	<0.5	<0.38
cis-1,2-Dichloroethene	22.84	<0.5	<0.38
Trichloroethene	25.98	12.2	9.24
Tetrachloroethene	29.88	16.9	12.80

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 16, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 117-N
Sampler Received: February 14, 1992
Sampler Analyzed: February 16, 1992
GC-MS Data File: 02162_05
Reported Sample Volume: 2.22 std L
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 117-N.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.53	<0.5	<0.23
cis-1,2-Dichloroethene	22.90	<0.5	<0.23
Trichloroethene	26.01	2.0	0.90
Tetrachloroethene	29.91	25.1	11.3

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS059, 2/16/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 16, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 119
Sampler Received: February 14, 1992
Sampler Analyzed: February 15, 1992
GC-MS Data File: 02152_08
Reported Sample Volume: 2.66 std L
Analyst: Raja Tannous

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 119.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.48	<0.5	<0.19
cis-1,2-Dichloroethene	22.86	<0.5	<0.19
Trichloroethene	25.99	0.5	0.19
Tetrachloroethene	29.89	3.9	1.47

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS060, 2/16/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 16, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 120
Sampler Received: February 14, 1992
Sampler Analyzed: February 15, 1992
GC-MS Data File: 02152_09
Reported Sample Volume: 2.72 std L
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 120.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.49	<0.5	<0.18
cis-1,2-Dichloroethene	22.87	<0.5	<0.18
Trichloroethene	25.99	<0.5	<0.18
Tetrachloroethene	29.89	4.0	1.47

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06002

Report Date: March 20, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 121-S
Sampler Received: March 14, 1992
Sampler Analyzed: March 19, 1992
GC-MS Data File: 03192_14
Reported Sample Volume: 0.67 std. L
Analyst: Raja Tannous

Report Approved By: ______________________

Quantitative Analysis of Sampler 121-S.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.45	<0.5	<0.75
cis-1,2-Dichloroethene	22.84	<0.5	<0.75
Trichloroethene	25.98	<0.5	<0.75
Tetrachloroethene	29.88	0.9	1.34

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06002

Report Date: March 17, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 125-S
Sampler Received: March 14, 1992
Sampler Analyzed: March 16, 1992
GC-MS Data File: 03162_09
Reported Sample Volume: 2.82
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 125-S.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.49	<0.5	<0.18
cis-1,2-Dichloroethene	22.86	<0.5	<0.18
Trichloroethene	26.00	1.7	0.60
Tetrachloroethene	29.90	78.6	27.9

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS080, 2/21/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 21, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 126-N
Sampler Received: February 15, 1992
Sampler Analyzed: February 20, 1992
GC-MS Data File: 02202_09
Reported Sample Volume: 2.67 std L
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 126-N.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.48	<0.5	<0.19
cis-1,2-Dichloroethene	22.86	<0.5	<0.19
Trichloroethene	25.99	0.8	0.30
Tetrachloroethene	29.89	7.6	2.85

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS066, 2/16/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 16, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 127-N
Sampler Received: February 14, 1992
Sampler Analyzed: February 16, 1992
GC-MS Data File: 02162_07
Reported Sample Volume: 2.64 std L
Analyst: Raja Tannous

Report Approved By: RS Hodgson

Quantitative Analysis of Sampler 127-N.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.47	<0.5	<0.19
cis-1,2-Dichloroethene	22.90	<0.5	<0.19
Trichloroethene	26.00	0.8	0.30
Tetrachloroethene	29.90	6.7	2.54

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

Field Blank Analytical Results for Tetrachloroethene, Trichloroethene, and the 1,2-Dichloroethene Isomers

MASS079, 2/21/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 21, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 002-N
Sampler Received: February 14, 1992
Sampler Analyzed: February 19, 1992
GC-MS Data File: 02192_04
Reported Sample Volume: Not given
Analyst: Raja Tannous

Report Approved By: R S Hodgson

Quantitative Analysis of Sampler 002-N.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.47	<0.5	
cis-1,2-Dichloroethene	22.86	<0.5	
Trichloroethene	25.99	<0.5	
Tetrachloroethene	29.88	0.7	

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS042, 2/12/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 12, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 020
Sampler Received: February 7, 1992
Sampler Analyzed: February 12, 1992
GC-MS Data File: 02122_04
Reported Sample Volume: Not given
Analyst: Al Hodgson

Report Approved By: Hodgson

Quantitative Analysis of Sampler 020.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.51	<0.5	
cis-1,2-Dichloroethene	22.90	<0.5	
Trichloroethene	26.03	<0.5	
Tetrachloroethene	29.93	2.7	

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS105, 3/20/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06002

Report Date: March 20, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 026-S
Sampler Received: March 14, 1992
Sampler Analyzed: March 19, 1992
GC-MS Data File: 03192_13
Reported Sample Volume: Not given
Analyst: Raja Tannous

Report Approved By: Hodgson

Quantitative Analysis of Sampler 026-S.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.46	<0.5	
cis-1,2-Dichloroethene	22.85	<0.5	
Trichloroethene	25.98	<0.5	
Tetrachloroethene	29.88	0.9	

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS098, 3/19/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06002

Report Date: March 19, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 031-S
Sampler Received: March 14, 1992
Sampler Analyzed: March 19, 1992
GC-MS Data File: 03192_05
Reported Sample Volume: Not given
Analyst: Al Hodgson

Report Approved By: Hodgson

Quantitative Analysis of Sampler 031-S.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.47	<0.5	
cis-1,2-Dichloroethene	22.86	0.7	
Trichloroethene	26.00	<0.5	
Tetrachloroethene	29.90	0.8	

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS074, 2/17/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 17, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 035-N
Sampler Received: February 15, 1992
Sampler Analyzed: February 17, 1992
GC-MS Data File: 02172_04
Reported Sample Volume: Not given
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 035-N.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.49	<0.5	
cis-1,2-Dichloroethene	22.87	<0.5	
Trichloroethene	26.00	<0.5	
Tetrachloroethene	29.90	0.8	

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS078, 2/21/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 21, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 036
Sampler Received: February 14, 1992
Sampler Analyzed: February 19, 1992
GC-MS Data File: 02192_03
Reported Sample Volume: Not given
Analyst: Raja Tannous

Report Approved By: Hodgson

Quantitative Analysis of Sampler 036.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.47	<0.5	
cis-1,2-Dichloroethene	22.85	<0.5	
Trichloroethene	25.99	<0.5	
Tetrachloroethene	29.89	<0.5	

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS099, 3/19/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06002

Report Date: March 19, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 053-S
Sampler Received: March 14, 1992
Sampler Analyzed: March 19, 1992
GC-MS Data File: 03192_07
Reported Sample Volume: Not given
Analyst: Al Hodgson

Report Approved By: Hodgson

Quantitative Analysis of Sampler 053-S.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.45	<0.5	
cis-1,2-Dichloroethene	22.84	<0.5	
Trichloroethene	25.98	<0.5	
Tetrachloroethene	29.88	1.2	

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 12, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 060
Sampler Received: February 7, 1992
Sampler Analyzed: February 12, 1992
GC-MS Data File: 02122_03
Reported Sample Volume: Not given
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of Sampler 060.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.54	<0.5	
cis-1,2-Dichloroethene	22.93	<0.5	
Trichloroethene	26.06	<0.5	
Tetrachloroethene	29.96	2.1	

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS109, 3/21/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06002

Report Date: March 21, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: 070-V
Sampler Received: March 14, 1992
Sampler Analyzed: March 21, 1992
GC-MS Data File: 03212_02
Reported Sample Volume: Not given
Analyst: Al Hodgson

Report Approved By: ______ Hodgson

Quantitative Analysis of Sampler 070-V.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.47	<0.5	
cis-1,2-Dichloroethene	22.86	<0.5	
Trichloroethene	25.99	<0.5	
Tetrachloroethene	29.90	<0.5	

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

System Blank Analytical Results for Tetrachloroethene, Trichloroethene, and the 1,2-Dichloroethene Isomers

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 12, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: System blank
Sampler Received: NA
Sampler Analyzed: February 8, 1992
GC-MS Data File: 02082_01
Reported Sample Volume: NA
Analyst: Al Hodgson

Report Approved By: Hodgson

Quantitative Analysis of System Blank.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.49	<0.5	
cis-1,2-Dichloroethene	22.88	<0.5	
Trichloroethene	26.02	<0.5	
Tetrachloroethene	29.92	<0.5	

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 12, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: System blank
Sampler Received: NA
Sampler Analyzed: February 9, 1992
GC-MS Data File: 02092_01
Reported Sample Volume: NA
Analyst: Al Hodgson

Report Approved By: Hodgson

Quantitative Analysis of System Blank.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.52	<0.5	
cis-1,2-Dichloroethene	22.90	<0.5	
Trichloroethene	26.03	<0.5	
Tetrachloroethene	29.92	<0.5	

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 12, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: System blank
Sampler Received: NA
Sampler Analyzed: February 12, 1992
GC-MS Data File: 02122_01
Reported Sample Volume: NA
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of System Blank.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.53	<0.5	
cis-1,2-Dichloroethene	22.91	<0.5	
Trichloroethene	26.05	<0.5	
Tetrachloroethene	29.96	1.7	

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 16, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: System blank
Sampler Received: NA
Sampler Analyzed: February 15, 1992
GC-MS Data File: 02152_10
Reported Sample Volume: NA
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of System Blank.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.47	<0.5	
cis-1,2-Dichloroethene	22.85	<0.5	
Trichloroethene	25.98	<0.5	
Tetrachloroethene	29.89	<0.5	

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS072, 2/16/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 16, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: System blank
Sampler Received: NA
Sampler Analyzed: February 16, 1992
GC-MS Data File: 02162_01
Reported Sample Volume: NA
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of System Blank.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.49	<0.5	
cis-1,2-Dichloroethene	22.87	<0.5	
Trichloroethene	26.00	<0.5	
Tetrachloroethene	29.90	<0.5	

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS076, 2/17/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 17, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: System blank
Sampler Received: NA
Sampler Analyzed: February 17, 1992
GC-MS Data File: 02172_01
Reported Sample Volume: NA
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of System Blank.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.47	<0.5	
cis-1,2-Dichloroethene	22.86	<0.5	
Trichloroethene	25.99	<0.5	
Tetrachloroethene	29.89	<0.5	

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS077, 2/21/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 21, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: System blank
Sampler Received: NA
Sampler Analyzed: February 19, 1992
GC-MS Data File: 02192_01
Reported Sample Volume: NA
Analyst: Raja Tannous

Report Approved By: A T Hodgson

Quantitative Analysis of System Blank.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.46	<0.5	
cis-1,2-Dichloroethene	22.85	<0.5	
Trichloroethene	25.98	<0.5	
Tetrachloroethene	29.88	<0.5	

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS083, 2/21/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06001

Report Date: February 21, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: System blank
Sampler Received: NA
Sampler Analyzed: February 20, 1992
GC-MS Data File: 02202_01
Reported Sample Volume: NA
Analyst: Al Hodgson

Report Approved By: Hodgson

Quantitative Analysis of System Blank.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.49	<0.5	
cis-1,2-Dichloroethene	22.88	<0.5	
Trichloroethene	26.01	<0.5	
Tetrachloroethene	29.91	<0.5	

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS087, 3/17/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06002

Report Date: March 17, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: System blank
Sampler Received: NA
Sampler Analyzed: March 16, 1992
GC-MS Data File: 03162_07
Reported Sample Volume: NA
Analyst: Al Hodgson

Report Approved By: Hodgson

Quantitative Analysis of System Blank.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.46	<0.5	
cis-1,2-Dichloroethene	22.85	<0.5	
Trichloroethene	25.98	<0.5	
Tetrachloroethene	29.89	<0.5	

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS093, 3/17/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06002

Report Date: March 17, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: System blank
Sampler Received: NA
Sampler Analyzed: March 17, 1992
GC-MS Data File: 03172_02
Reported Sample Volume: NA
Analyst: Raja Tannous

Report Approved By: ______________________

Quantitative Analysis of System Blank.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.46	<0.5	
cis-1,2-Dichloroethene	22.84	<0.5	
Trichloroethene	25.99	<0.5	
Tetrachloroethene	29.89	<0.5	

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS097, 3/19/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06002

Report Date: March 19, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: System blank
Sampler Received: NA
Sampler Analyzed: March 19, 1992
GC-MS Data File: 03192_04
Reported Sample Volume: NA
Analyst: Al Hodgson

Report Approved By: A T Hodgson

Quantitative Analysis of System Blank.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.46	<0.5	
cis-1,2-Dichloroethene	22.85	<0.5	
Trichloroethene	25.99	<0.5	
Tetrachloroethene	29.89	<0.5	

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

MASS108, 3/21/92

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06002

Report Date: March 21, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative
Instrument: Envirochem UNACON 810A & HP 5971A
Sampler No.: System blank
Sampler Received: NA
Sampler Analyzed: March 21, 1992
GC-MS Data File: 03212_01
Reported Sample Volume: NA
Analyst: Al Hodgson

Report Approved By: Hodgson

Quantitative Analysis of System Blank.

Compound	RT (min)	Mass (ng)	Conc. (ug m^{-3})
trans-1,2-Dichloroethene	19.47	<0.5	
cis-1,2-Dichloroethene	22.86	<0.5	
Trichloroethene	25.99	<0.5	
Tetrachloroethene	29.90	<0.5	

Comments: The limits of quantitation are estimated to be 0.5 ng for all four compounds.

Analytical Results for Vinyl Chloride

NARRATIVE REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06002
Report Date: March 16, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative Analysis Vinyl Chloride

Report Approved By: R S Hodgson

Quantitative GC-MS Analysis of Vinyl Chloride

Methods

The samples were collected on multisorbent samplers (Model ST-032, Envirochem, Inc.) which contain Tenax-TA, Carboxen carbon molecular sieve and activated charcoal in series. These samplers have been validated for the collection of air toxic compounds by Broehler *et al.* (1990). Prior to being sent to the field for use, all samplers were conditioned using standard procedures and were then individually analyzed to ensure that they did not contain measurable amounts of vinyl chloride. All samplers passed this screening test. Samplers were returned to the laboratory from the field by overnight air freight. They were packaged with dry ice to maintain them at freezing temperatures.

A certified gas standard for vinyl chloride was obtained from Scott Specialty Gases, Inc. The concentration of the standard was 1.03 ppm (±2 percent) vinyl chloride in air. Prior to the anaylsis of samples, a multi-point calibration was prepared for vinyl chloride by injecting measured volumes of the standard onto conditioned multisorbent samplers using gas-tight syringes. The injected masses of vinyl chloride were calculated using the ideal-gas law. These samplers were analyzed in the same manner as the samples. On each day of analysis of samples, at least one calibration standard was prepared and analyzed.

The samplers were analyzed for vinyl chloride within two days of receipt from the field. The standard thermal desorption-gas chromatography-mass spectrometry method was optimized to achieve maximum sensitivity for vinyl chloride. Because of the need to detect a very small mass of vinyl chloride and the potential for contamination at this low level, a special analytical scheme was utilized. First, a system blank was analyzed. This was followed by the analysis of a field blank. Finally, a sample collected in a house was analyzed. This scheme was repeated for each primary house sample. Each duplicate house sample was preceded by a system blank.

The quality assurance program used for the analysis for volatile organic compounds is described in the document, BAA-SOP-92.01. Standard operating procedures describe all aspects of sampler conditioning, storage and analysis.

Results

The added precautions sucessfully ensured that vinyl chloride was not detected in either the system or the field blanks. The lower limit of quantitation for vinyl chloride was, therefore, based on the signal-to-noise ratio for the response of the mass spectrometer to vinyl chloride. A signal-to-noise ratio of ten was selected as a reasonable limit. Based on the calibration, the limit of quantitation is equaivalent to 0.2 ng, or 0.02 ug m^{-3} for a ten-liter sample. Vinyl chloride was only detected above the limit of quantitation in two of the six house samples that were analyzed. These were paired samples from one house. Vinyl chloride was not dtected in the two larger-volume soil-gas samples that were analyzed. The concentrations of vinyl chloride in the samples (ug m-3) were calculated using the sample volumes reported in standard liters. The results are presented in Report MASS086, dated March 16, 1992. The results for the paired house samples 077-V and 055-V are within 20 percent of each other.

ANALYTICAL REPORT

Berkeley Analytical Associates
904 Wright Avenue, No. 12
Richmond, CA 94804
510/236-2325
FAX 510/236-2335

Job Code: 06002

Report Date: March 16, 1992
Client: Envirocon, Inc.
Client Job Number: 140101, BN/Livingston
Analysis Type: GC-MS SIM, Quantitative Analysis of Vinyl Chloride
Instrument: Envirochem UNACON 810A & HP 5971A
Samplers Received: March 14, 1992
Samplers Analyzed: March 14-15, 1992
Analyst: Al Hodgson

Report Approved By:

Quantitative Analysis of Vinyl Chloride.

Sampler No.	GC-MS Data File	Volume (std. L)	RT (min)	Mass (ng)	Conc. (ug m^{-3})
House - Primary & Blank Samples					
System	03142_04	NA		<0.2	
007-V	03142_05	Blank		<0.2	
109-V	03142_06	8.33		<0.2	<0.02
System	03142_07	NA		<0.2	
076-V	03142_08	Blank		<0.2	
077-V	03142_09	8.12	13.83	6.5	0.80
System	03142_10	NA		<0.2	
111-V	03142_11	Blank		<0.2	
107-V	03142_12	9.09		<0.2	<0.02
System	03142_13	NA		<0.2	
115-V	03142_14	Blank		<0.2	
112-V	03142_15	8.94		<0.2	<0.02
House - Duplicate Samples					
System	03152_05	NA		<0.2	
004-V	03152_06	6.01		<0.2	<0.03
System	03152_07	NA		<0.2	
055-V	03152_08	4.20	13.82	2.7	0.64
Soil-Gas Samples					
048-V	03142_18	1.32		<0.2	<0.15
045-V	03152_04	1.33		<0.2	<0.15

Data Validation Report

Data Validation Report for Indoor and Outdoor Ambient Air Analyses
Livingston Rail Yard, Livingston, Montana
February and March 1992 Indoor Air Investigation

The results for analyses conducted by Berkeley Analytical Associates have been evaluated for data usability in the Baseline Health Risk Assessment. The data validation process includes evaluation of holding times, comparisons of primary sample results with field blank results, evaluation of laboratory system blank results, comparisons of primary sample results with field duplicates results, and evaluation of the field sampling protocols and field measurements. The samples were collected during two sampling events, one from February 4 through February 14, 1992, and a second from March 11 through March 13, 1992. Tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (c-DCE), and trans-1,2-dichloroethene (t-DCE) analyses were conducted on samples collected in both sampling events. Vinyl chloride analyses were conducted on samples collected during the March 1992 sampling event.

February, 1992 Sampling Event

All samples were analyzed within nine days of sample collection with all primary field samples being analyzed within seven days of sample collection. A study conducted by Boehler *et al.*, (1990) indicates that acceptable storage times for volatile organic compounds collected on multisorbent samplers are 150 days for PCE, 60 days for TCE, and 7 days for 1,1-dichloroethene and 1,1-dichloroethane. The study did not evaluate c-DCE or t-DCE storage times, but they should be similar to the storage times of 1,1-dichloroethene and 1,1-dichloroethane. Duplicate analytical results for c-DCE and t-DCE show equal or higher concentrations in the duplicates than in the respective primary samples. Therefore, the holding times of eight to nine days for the duplicate samples does not appear to have adversely impacted the analytical results.

One field blank was analyzed for each of the following five sample locations:

the ambient air sample at the BG-1 residence; the basement sample at the NE-1 residence; the basement sample at the NE-2 residence; the basement sample at the SE-5 residence; and the upstairs sample at the SE-8 residence. None of the field blanks contained detectable masses of TCE, c-DCE, or t-DCE. Four of the five field blanks contained PCE, with a concentration range of 0.7 to 2.7 nanograms (ng). The PCE concentration (2.1 ng) in the field blank collected at the SE-8 residence is greater than 20% of the upstairs PCE result (5.0 ng). The PCE mass result was changed from 5.0 ng to <5.0 ng and the concentration result was changed from 1.83 ug/m^3 to <1.83 ug/m^3. Eight system blanks were analyzed by Berkeley Analytical Associates. Only one system blank contained a detectable mass of PCE (1.7 ng). None of the system blanks contained detectable masses of TCE, c-DCE, or t-DCE. The detected concentration of PCE did not impact any of the field sample results.

One field duplicate was collected at the following five sample locations: the NE-2 basement; the SE-1 upstairs; the SE-2 basement; the SE-5 basement; and the SE-8 basement. Table 1 lists the relative percent differences for detected compounds. Relative percent differences ranged from 8.5% to 17.3% for PCE which shows good precision with both collection and analysis of the samples. Relative percent differences ranged from 0% to 47.4% for TCE. Duplicate comparisons at NE-2 and SE-5 had elevated relative percent differences for TCE of 36.8% and 47.4%, respectively. Although the percent difference is 36.8% for TCE at the NE-2 basement sample, the concentrations are low and the absolute difference is only 0.14 ug/m^3. The poor precision for the TCE analytical results at the SE-5 basement sample is more difficult to interpret because the PCE concentration is higher in the duplicate while the TCE concentration is lower in the duplicate. Therefore, the TCE analytical results for SE-5 should be regarded as qualitative. Relative percent differences ranged from 3.8% to 4.4% for c-DCE.

No problems were encountered during the collection of samples in the background study area. The NE-1 residence was resampled on February 14 because the upstairs sample collected on February 5 is invalid. The percent differences for

Table 1: Comparison of Primary and Duplicate Results for the February 1992 Samples.

Resident	Chemical Name	Primary Concentration ug/m3	Duplicate Concentration ug/m3	Relative Percent Difference %
NE-2	PCE	18.9	17.2	9.4
NE-2	TCE	0.45	0.31	36.8
SE-1	PCE	27	24.6	9.3
SE-1	TCE	0.77	0.68	12.4
SE-2	PCE	6.31	6.87	8.5
SE-2	TCE	0.3	0.31	3.3
SE-2	c-DCE	0.26	0.27	3.8
SE-5	PCE	43.2	51.4	17.3
SE-5	TCE	2.35	1.45	47.4
SE-8	PCE	1.02	0.93	9.2
SE-8	TCE	0.49	0.49	0
SE-8	c-DCE	0.22	0.23	4.4
SE-8	t-DCE	0.22	<0.19	NC

Table 2: Comparison of Primary and Duplicate Results for the March 1992 Samples.

Resident	Chemical Name	Primary Concentration ug/m3	Duplicate Concentration ug/m3	Relative Percent Difference %
NE-1	PCE	27.9	26.5	5.1
NE-1	TCE	0.6	0.61	1.7
NE-4	PCE	5.66	6.18	8.8
NE-4	TCE	0.57	1.3	78
NE-4	c-DCE	<0.16	0.63	NC
NE-4	t-DCE	<0.16	0.39	NC
SE-2	Vinyl Chloride	0.8	0.64	22

NC Not calculated because one value was non-detected.

the initial flow rates and final flow rates for the two samplers at the upstairs sample location were 39% and 34% (Table 1 of the text) and are outside the acceptable percent difference. The upstairs sample collected on February 14 at the NE-1 residence is also invalid due to an error with the sample's chain-of-custody. A valid sample was collected on March 12, 1992. The samples collected at the SE-2 residence on February 5 are invalid. The basement sample location had percent differences between the initial flow rates and final flow rates for the two samplers of 47% and 41% (Table 1 of the text). The upstairs sample is invalid because the air sampling pump failed during the collection of the sample. The SE-2 residence was resampled without difficulty on February 13. The basement sample collected on February 4 at the SE-4 residence is invalid, due to failure of the air sampling pump. The SE-4 residence was resampled without difficulty on February 13. The basement sample at the U-1 residence is invalid, due to an error with the sample's chain-of-custody. A valid sample was collected on March 13, 1992. An additional ambient air sample was collected on February 11 in the southeast study area. Problems with the air flow control valve caused the percent differences for the initial and final flow rates to be 45% and 52% (Table 1 of the text) and the additional sample is invalid.

March, 1992 Sampling Event

All PCE, TCE, c-DCE, and t-DCE analyses were conducted within nine days of sample collection with all primary field samples being analyzed within seven days of sample collection. The study conducted by Boehler *et al.*, (1990) indicates that an acceptable storage time for vinyl chloride is 7 days. All vinyl chloride analyses were conducted within four days of sample collection.

One field blank was collected at each of the following four sample locations and analyzed for PCE, TCE, c-DCE, and t-DCE: the basement of the NE-1 residence; the basement of the NE-4 residence; the soil gas at the BG-2 residence; and the soil gas at the SE-2 residence. None of the field blanks contained detectable masses of TCE or t-DCE. Three of the four field blanks contained PCE, with a range of 0.7 to 1.2

nanograms (ng). The field blank for the NE-4 basement sample contained 0.7 ng of c-DCE. The sampler tubes for the NE-4 basement sample contained excessive water and the c-DCE and t-DCE analyses were lost. Four PCE, TCE, c-DCE, and t-DCE system blanks were analyzed by Berkeley Analytical Associates. No system blanks contained detectable masses of PCE, TCE, c-DCE, or t-DCE.

One field blank was collected at each of the following four sample locations: the basement of the BG-2 residence; the basement of the NE-1 residence; the basement of the SE-2 residence; and the basement of the SE-8 residence. None of the field blanks contained detectable masses of vinyl chloride. Six vinyl chloride system blanks were analyzed by Berkeley Analytical Associates. None of the system blanks contained detectable masses of vinyl chloride.

One field duplicate was collected at each of the following two sample locations and analyzed for PCE, TCE, c-DCE, and t-DCE: the upstairs of the NE-1 residence; and the upstairs of the NE-4 residence. Table 2 lists the relative percent differences for detected compounds. Relative percent differences ranged from 5.1% to 8.8% for PCE which shows good precision with both collection and analysis of the samples. Relative percent differences ranged from 1.7% to 78% for TCE. The duplicate sample for the NE-4 upstairs sample also contained detectable concentrations of c-DCE and t-DCE. The poor precision of TCE, c-DCE, and t-DCE for the NE-4 upstairs sample indicates a problem with sample collection. Therefore, the TCE, c-DCE and t-DCE analytical results for NE-4 should be regarded as qualitative.

No problems were encountered during the collection of samples during the March, 1992 sampling event. The basement samples 024-S and 025-S at the NE-4 residence contained excessive water. The analyses for sample 024-S were lost because excessive water desorbed from the sampler tube interfered with the instrument. Only PCE and TCE results were quantified for sample 025-S due to excessive water in the sampler. A discussion of the analytical difficulties is provided by Berkeley Analytical Associates in "Field Sample Analytical Results for

Tetrachloroethene, Trichloroethene, and the 1,2-Dichloroethene Isomers," which is located at the beginning of this appendix.

Reference

Boehler, W.F., R.L. Huttie and K.M. Hill, "Evaluation of a Non Cryogenic Automated Multitube Thermal Desorption System for the Analysis of Air Toxics," *Proceedings of the 1990 EPA / A&WMA International symposium. Measurement of Toxic and Related Air Pollutants*, Raleigh, NC, May 1990, pp. 699-708.

Quality Assurance Information
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Quality Assurance Program for the Analysis of VOC and TVOC

BAA-SOP-92.01
Revised 1/22/92

The quality assurance program described in this document reflects the actual operating and quality control programs in effect at Berkeley Analytical Associates (BAA) for the analysis of volatile organic compounds (VOC) and total VOC (TVOC). The quality assurance program is designed to ensure the integrity of the results reported for these analyses.

Qualifications and Responsibilities of Personnel

The owners and operators of BAA are Alfred T. Hodgson, Research Director, and Raja S. Tannous, Laboratory Director. There are no employees at this time.

Mr. Hodgson has been a Staff Scientist in the Indoor Environment Program at Lawrence Berkeley Laboratory, University of California, Berkeley, since 1982. In this capacity he conducts original research on the sources and health impacts of airborne organic compounds in commercial and residential buildings including assessments and modeling of exposures to volatile organic compounds emitted by consumer products and interior-finish materials. He also develops and validates methods for the sampling and analysis of airborne organic compounds. This work has resulted in a number of publications and presentations at scientific meetings. Among these is an ASTM publication of a validation study of the multisorbent sampler for volatile organic compounds.

Mr. Tannous, is a graduate of the Biochemistry Department at the University of California, Berkeley and a former member of the Organo-metallic Chemistry Group at Lawrence Berkeley Laboratory. He has considerable laboratory experience in the synthesis of organic and organometalic compounds. This work includes the synthesis of polymeric materials for use as column packings for High-Performance Liquid Chromatography applications and the development of methods to speciate and remove toxic trace elements from waste water.

Documentation of Standard Operating Procedures

The standard operating procedures (SOPs) that are currently in effect at BAA for the analyses of VOC and TVOC are listed below. These SOPs are incorporated into and made a part of the quality assurance program.

ID Number	Title	Date	Pages
BAA-SOP-91.01	Collection of Samples for Analysis of Volatile Organic Compounds in Indoor Air using Multisorbent Samplers	8/18/91	5
BAA-SOP-91.02	Logging of Multisorbent Samplers Returned for Analysis	8/13/91	1
BAA-SOP-91.03	Conditioning of Multisorbent Samplers for Use	8/13/91	3
BAA-SOP-91.04	Analysis of Total Volatile Organic Compounds (TVOC)	8/17/91	5
BAA-SOP-91.05	Preparation and Use of Standard Gas Mixtures in Static Dilution Bottles	8/17/91	5
BAA-SOP-91.06	GC-MS Analysis of Volatile Organic Compounds (VOC)	9/15/91	10
BAA-SOP-91.07	Logging and Storage of Standards	8/17/91	2
BAA-SOP-91.08	Archiving of GC-MS Data Files	7/6/91	2
BAA-SOP-91.09	Laboratory Notebooks	7/6/91	2

Sampling Procedures

The sampling procedures are described in BAA-SOP-91.01. Copies of this SOP are provided to all clients who rent multisorbent samplers from BAA. The SOP provides detailed instructions for the handling, transport, labeling and storage of multisorbent samplers and for the collection of valid samples. The measurement of air flow rates is described. Emphasis is placed on procedures to prevent the contamination of samples. Clients are encouraged to incorporate this SOP into their own documentation of sampling procedures.

Sampler Conditioning

BAA-SOP-91.03 describes the conditioning of multisorbent samplers. A unique identification number is etched onto each sampler prior to its first use. The numbers and the commissioning dates are recorded in the general laboratory notebook. These numbers identify the samplers for all subsequent usage. Samplers are conditioned prior to each use following the procedures in the SOP. At least one sampler out of every batch of six samplers that are conditioned is measured for residual contamination following the procedures in BAA-SOP-91.04. The sampler must contain less than 20 ng of carbon, otherwise the batch of samplers is reconditioned and background contamination is again measured. The date of conditioning and the numbers of the conditioned samplers are recorded in the general laboratory notebook. The samplers are packaged, and the date of

conditioning is written on the package. Conditioned samplers are stored in a dedicated freezer at -15° C.

Sample Custody

Sample custody procedures are described in BAA-SOP-91.02. When samples are delivered to the laboratory, the date and time of receipt, the client's name and job number, and the sampler numbers are recorded in the general laboratory notebook. A unique BAA code is assigned to the job. The condition of all samples is determined, and any irregularities are recorded. The sampler numbers are checked to see that they match the client's list of samplers. If there are any discrepancies or other problems with the samplers, the client is contacted before proceeding with any analyses. The samplers are repackaged, and the package is labeled with the job code, the client's name, the date and the type of analysis. The samplers are stored in a dedicated freezer at -15° C.

Any chain of custody forms provided by the client are filled out upon receipt of the samples and are filed with the other documents pertaining to the job. These forms are completed and returned to the client when the analyses are complete. Once samples are received, their custody is not transferred within or outside of BAA.

Analytical Procedures

The analyses of VOC and TVOC that are routinely performed by BAA are described in BAA-SOP-91.06 and BAA-SOP-91.04, respectively. The apparatus used in these analyses is described. Instrument settings are prescribed, and operating procedures are described in detail. The purpose of these SOPs is to ensure that valid, reproducible results are obtained.

Each GC-MS analysis is assigned a unique data-file name that is derived from the date of the analysis and the daily consecutive analysis number. Additional information regarding the sample or standard is entered into the data-file header. The data-file name permanently identifies the analysis.

A consecutive run number and date is assigned by the system integrator to each analysis of a standard or sample for TVOC. This number and date identifies the standard or sample.

Calibration Procedures

Calibration for the TVOC analysis is described in BAA-SOP-91.04. The composition of the liquid mixture of C_6-C_{12} normal alkane hydrocarbons that is used for calibration is given. A fresh liquid mixture is prepared at least every six months. On each day that analyses are performed, a standard gas mixture is prepared by injecting 3 ul of the liquid mixture into a 2-L static dilution bottle. BAA-SOP-91.05 describes the preparation and use of standard gas mixtures. On the day of analysis, a minimum of three standards are run spanning the response range of the samples. An R^2 value of 0.95, or higher, for a linear regression of the data

points is considered to be acceptable performance. At least one additional standard is run for every ten additional samples that are analyzed.

Mass calibration of the GC-MS is described in BAA-SOP-91.06. The MS is mass tuned prior to beginning the analysis of a batch of samples and standards for a particular job. The MS is not re-tuned until all of the samples and standards for a job have been completed unless there is a problem. The MS is tuned for mid-mass sensitivity using perflourotributylamine. The performance criteria are m/z 69 = base peak; m/z 219 = >30% relative abundance; and m/z 264 = >5% relative abundance.

A mass of 121 ng of 1-bromo-4-fluorobenzene is added as an internal standard to all samples and standards immediately prior to their analysis. The compound serves as a marker for retention time and as an indicator for the mass tuning and sensitivity of the MS. BAA-SOP-91.05 describes the preparation of the gas standard and the procedure for spiking the multisorbent samplers with the internal standard.

The maintenance of the inventory of compounds used as authentic standards is described in BAA-SOP-91.07. A record of the purchase of all standards is maintained so that each standard can be traced back to its original purchase order. A unique accession number is assigned to each standard. The entry of a standard into the database is recorded in the general laboratory notebook. The accession number is written on all containers of the standard.

Gas standards of the compounds of interest are prepared as described in BAA-SOP-91.05. First, a liquid mixture of the compounds is prepared so that the relative masses of the compounds in the mixture approximates that of the expected masses of the compounds in the samples. The mixture is assigned a unique identification number. If the mixtures do not contain very volatile compounds, they can be stored for a period of a week. Otherwise, they are used on single day and discarded after this use. Standard gas mixtures are prepared from the liquid mixtures using 2-L static dilution bottles. The gas mixtures are used on a single day and discarded. Precautions for the preparation of the gas mixtures are described in the SOP. The SOP also gives the procedures and equations for calculating the concentrations of compounds in the liquid and gas mixtures. Details regarding the composition and preparation of each standard are recorded in the general laboratory notebook.

The calibration procedures for quantitative GC-MS analyses are described in BAA-SOP-91.06. Typically internal-standard calibrations are used; however, external-standard calibrations may be used instead. Regardless of the type of calibration being performed, a mass of 121 ng of the internal standard is added to each sample and standard immediately prior to its analysis.

For each compound, the most abundant mass ion (base peak) is usually selected as the quantitative ion. At least one characteristic ion is selected for confirmation of the compound's identity. The identity is considered to be confirmed if both the retention time and the spectra or the ratio of the confirmation ion to the quantitative ion for the compound in the sample match those of the authentic standard. The retention time should be within ±0.15 minutes of the expected value, and the spectra match quality should be at least 95 percent.

Three or more standards spanning the expected mass ranges of the selected compounds in the samples are analyzed on the first day of analysis of a batch of samples and standards for a particular job. The standards are approximately evenly spaced. An R^2 value of 0.95, or higher, for a linear regression of the data points for each compound is considered to be acceptable performance. At least one additional standard is run for every ten additional samples that are analyzed. Also, at least one standard is run on each subsequent day of analysis of samples for a particular job. The additional calibration points are compared to the original calibrations. A deviation in the peak area response of a compound by more than ±15 percent of the expected value, indicates a possible calibration problem, and the multi-point calibration for this compound is re-run. If there are no problems, all of the calibration points for each compound are combined into a single calibration at the conclusion of the analysis of samples and standards for a job. Again, an R^2 value of 0.95, or higher, for a linear regression of the data points for each compound is considered to be acceptable performance. The combined calibrations are used to calculate the masses of the compounds in the samples.

Internal Quality-Control Checks

The periodic mass calibration of the GC-MS optimizes the performance of the instrument, ensures accurate mass assignment, and provides the desired relative abundances across the spectrum.

The internal standard is used to evaluate the performance of the GC-MS system. The internal standard should elute within ±0.15 minutes of its expected retention time; the response factor (peak area/nanogram of standard) should be within its expected range and should vary by no more than ±15 percent relative standard deviation throughout an analysis session; and the mass spectra should meet the expected criteria established in the SOP.

Blanks are used to assess the possible contamination of samplers. Conditioned, blank multisorbent samplers are used as system blanks. They are analyzed at a frequency of at least one blank for every ten samples for a particular job. If there are fewer than ten samples, at least one system blank is analyzed. Clients are encouraged to collect field-handling blanks. When collected, field-handling blanks are substituted for system blanks.

The standards are added to the samplers and analyzed in a manner that mimics the collection and analysis of samples. Therefore, biases which might be introduced by the analytical system are effectively cancelled. The evaluation of the calibration curves provides information about the validity of the gas standards and the calibration procedure. In particular, low sensitivity, non-linear responses, and significant negative or positive intercepts indicate problems that need to be investigated.

Analytical precision is largely determined by the goodness-of-fit of the calibration points for a compound to a linear regression. This determines the size of the confidence interval around the regression line which, in turn, determines the confidence interval for the calculated masses. Analytical precision can be improved by increasing the number of calibration points and by spacing them evenly over the mass range. The calibration procedures and criteria are selected to ensure that acceptable analytical precision is achieved.

The analysis of replicate samples addresses the additionally variability that may be introduced during the collection of samples. Clients are encouraged to collect duplicate samples at a minimum frequency of one duplicate for each ten samples with at least one duplicate per batch of samples to be analyzed. Duplicate sample pairs should be simultaneously collected at the same location using the same air flow rate.

Data Reduction, Reporting and Record Maintenance

The calculation and reporting of results for GC-MS analyses are described in BAA-SOP-91.06. BAA-SOP-91.04 describes the calculation and reporting of results for TVOC. All of the data used in the calculations are recorded in the general laboratory notebook. A standard worksheet is used for the GC-MS analyses as a consolidated record of the pertinent information and as to guide to the calculations. A file is maintained for each job that contains copies of reports, completed worksheets, all printed data outputs, and all other documents pertaining to the job.

Before reports are sent to clients, the data and calculations are checked for accuracy. This includes comparing sample identifications, run numbers, and data-file names in the reports to the original records. Any discrepancies are corrected, and the report is signed and dated.

All GC-MS data files are archived for future reference as described in BAA-SOP-91.08. Following each day of analysis, the data files recorded during the day are backed up onto a tape cartridge with an encoded identifier. An entry is made in the general laboratory notebook noting the tape identifier and the data file names that were backed up.

Instructions for record keeping in laboratory notebooks are described in BAA-SOP-91.09. Each notebook is identified by a number. An index notebook is maintained in which all new notebooks are entered.

Assessment of Limits of Detection and Precision

The limits of detection are calculated from the analysis of blanks or low standards. If there is a system of field blank for a compound, the detection limit for that compound is calculated as three times the standard deviation for a minimum of three replicate analyses of the blank. If there is no blank, the detection limit is calculated as three times the standard deviation for three or more replicate analyses of a low standard that is within a factor of ten of the estimated detection limit.

When three or more analyses of replicate standards or samples have been performed, precision is calculated and reported as the relative standard deviation (RSD = standard deviation / mean * 100). A relative standard deviation of ±15 percent is considered acceptable performance.

Preventative Maintenance

The analytical instrumentation is maintained according to the manufacturers' recommended schedules as described in the hardware manuals. Instrument maintenance is recorded in a dedicated logbook.

Corrective Action

Prior to the analysis of samples and standards for a particular job, the GC-MS is mass tuned and the system vacuum is checked. The tune reports are saved in a permanent file. The most recent report is compared with the previous reports to diagnose problems such as decreased sensitivity. If the report indicates that the ion source is contaminated or that there are other problems, the necessary service is performed before proceeding with any analyses.

Corrective action is also taken whenever the quality-control data are outside of acceptable limits. The need for corrective action is primarily determined during the analysis of standards and samples and the performance of the internal quality-control checks. No data are reported until the cause of the problem is determined and corrected. Out-of-control events, their cause(s) and corrective action taken are recorded in the general laboratory notebook.

Appendix C

Toxicological Profiles for Tetrachloroethene, Trichloroethene, the 1,2-Dichloroethene Isomers, and Vinyl Chloride

TETRACHLOROETHYLENE

General Data

General Background Information

Tetrachloroethylene (tetrachloethene, perchloroethylene, PCE, perc) is a nonflammable liquid solvent commonly used in dry cleaning, de-sooting and metal degreasing operations, and as a solvent for fats, greases, waxes, rubber and gums. It is also used as a heat transfer medium. Products that may contain PCE include auto brake quieters and cleaners, suede protectors, paint removers and strippers, water repellants, silicone lubricants, belt lubricants and dressings, specialized aerosol cleaners, fabric finishers, spot removers, adhesives and wood cleaners (ATSDR, 1987, Verschueren, 1983).

Chemical/Physical Properties

Property	Value	Reference
Chemical Formula	CCL_2CCL_2	U.S. EPA, 1986
Molecular Weight	165.83	U.S. EPA, 1986
Boiling Point	121.4°c	U.S. EPA, 1986
Melting Point	-22.7°c	U.S. EPA, 1986
Water Solubility	150. mg/l	U.S. EPA, 1986
Vapor Pressure	14 mm Hg (20°C)	Verschueren, 1983
Henry's Law Constant	$2.59x10^{-2}$	U.S. EPA, 1986
Koc (ml/g)	364	U.S. EPA, 1986
log kow (1/kg)	2.6	U.S. EPA, 1986

Fate and Transport

The majority of PCE used in the U.S. is released to the atmosphere by volatilization, although that which has become heavily contaminated with grease and oil is disposed of in the form of liquid or solid waste, which is discharged directly to the land or surface water. When released to surface water, volatilization occurs rapidly, and when released to soil, PCE either volatilizes or leaches to the groundwater, due to its medium-to-high soil mobility, and low adsorption potential. PCE in the atmosphere may be transported to the soil or surface water by wet deposition (ATSDR, 1988). PCE has a low bioconcentration potential, with a BCF of 31 (U.S. EPA, 1986).

In the atmosphere, PCE reacts with photochemically produced hydroxyl radicals producing phosgene and chloroacetylchlorides (ATSDR, 1988). PCE's half life in air is 47 days (EPA, 1986). In surface water and soil, biodegradation and hydrolysis appear to be the most important transformation processes, although these appear to occur slowly. In surface water, a half life from 1-30 days is reported (U.S. EPA, 1986). In groundwater, where volatilization cannot occur, PCE can be very persistant. Under certain conditions, PCE in groundwater may slowly biodegrade to trichlorothylene, and then to dichloroethylene and vinyl chloride (U.S. EPA, 1987).

Toxicity Data

Pharmacokinetics

PCE is readily absorbed following inhalation and ingestion. In contrast, absorption following dermal exposure is poor. The adipose tissue appears to be the primary site of PCE distribution. The primary urinary metabolites of PCE in humans appear to be trichloroacetic acid and trichloroethanol. The main excretion pathway for unmetabolized PCE is through expired air. Urinary excretion of metabolites account for only a small percentage of the absorbed dose.

In laboratory animals, PCE exhibits similar pharmocokinetics as in humans with the exception that oxalic acid is also found in the urine. The metabolism of PCE is believed to be mediated by the cytochrome P-450 catalyzed oxidation reaction involving the formation of an epoxide intermediate.

Human Toxicological Profile

Acute inhalation of high concentrations of PCE in air has been shown to produce central nervous system (CNS) effects leading to dizziness, headache, sleepiness, confusion, nausea, difficulty in speaking and walking, and possibly unconsiousness and death. Stewart et al. (1970) reports that headache, dizziness, difficulty in speaking and sleepiness occured in 11 individuals exposed to 101 ppm PCE for 7 hours. Inhalation also produces liver and kidney toxicity after chronic exposure.

The effects seen following ingestion appear to parallel those observed after inhalation. PCE was previously used as a treatment for hookworm infestation, and therapeutic oral exposure produced narcotic effects, inebriation, and exhilaration at doses of 2.8 to 4 ml (4.2 to 6g). Acute ingestion has also produced hepatic and renal toxicity. No data are available on human dermal exposure to PCE.

Mammalian Toxicology and Significant Studies

The acute oral LD_{50} (single-dose 14 day) for PCE in male rats is 3835 mg/kg, while in female rats the value is 3005 mg/kg. Tremors, ataxia, and CNS depression preceeded death, and hemorrnagic lungs and adrenals were observed in some animals (Hayes, et al., 1986). An oral LD_{50} of 8100 mg/kg was reported for mice (Wenzel and Gibson, 1951). A 4-hour inhalation LC_{50} of 5200 ppm for mice was reported by Friberg et al., (1953).

Damage to the CNS by PCE has been associated with hypertrophy and/or proliferation of astroglial cells. Rosengren et al. (1986) reported an increase in brain level S-100 (an astroglial protein) after continuously exposing guinea pigs to 320 ppm PCE for 3 months. Briving et al. (1986) reported a PCE-induced increase in free glutamine in the hippocampus, and a significant decrease in brain taurine content in gerbils exposed to 120 ppm PCE continuously for 12 months. Taurine is a known non-specific membrane stabilizer, thus its reduction may lead to alterations in nerve impulse transmission and could be responsible for PCE's neurotoxic effects. Rosengren et al. (1986) reported a decreased DNA content in the brain of gerbils exposed continuously to PCE concentrations as low as 60 ppm.

Moderate fatty degeneration of the liver was reported in mice 1 day following a single 4-hour exposure to 200 ppm PCE, but not 3 days after exposure. Mice exposed similarly to 400, 800 or 1600 ppm PCE were observed to have moderate to massive fatty degeneration 1 and 3 days after exposure (Kylin et al., 1963). Mice exposed to PCE continuously for 30 days at concentrations of 9-150 ppm exhibited gross abnormal pathological appearances of the liver and significantly increased liver weights. At concentrations of 37-150 ppm, significantly increased butyrylcholinesterase activity was observed (Kjellstrand, et al., 1984). Burben and O'Flaherty (1985) reported increased liver weight and triglycerides at 100-2000 mg/kg PCE in corn oil, decreased G6P and increased SGPT at 500-2000 mg/kg, and histological changes in the liver at 200 and 1000 mg/kg doses.

Toxic nephropathy was observed in mice exposed to 386 and 1072 mg/kg PCE in corn oil via gavage, 5 days/week for 78 weeks. Rats exposed to 230 to 470 ppm PCE 8 hours/day, 5 days/week for 7 months exhibited swelling of the liver and kidney, and congestion in the spleen. The 70 ppm treatment group showed no effect.

Schwartz et al. (1975) exposed pregnant rats to 300 ppm PCE for 7 hours/day on day 6 through 15 of gestation. Pregnant mice exhibited a 4% to 5% reduction in body weight, an increase in liver weight, and twice the number of resorptions per implantations as controls. In the mouse pups, significant subcutaneous edema, delayed skull ossification, and the presence of split sternebrae were observed.

The NCI (1977) found PCE that contained stabilizers to be a liver carcinogen in B6C3F mice administered 386 to 1,072 mg/kg PCE by gavage. The NTP (1986) exposed rats to 0, 200, 400 ppm and mice to 0, 100 and 200 ppm PCE. Male rats exhibited increased incidence in mononuclear cell leukemia, and an increased incidence of renal tubular ademona/carcinoma (combined). PCE induced hepatocellular carcinomas in male and female mice at both doses.

Genotoxicity

Several genotoxicity studies have been performed for PCE employing a variety of in-vitro and in-vivo assays. These have revealed little or no evidence of genotoxic activity by PCE (U.S. EPA, 1987).

Regulations and Standards

Tetrachloroethylene is considered a class B2 carcinogen by the EPA. The carcinogenic potency factors for oral and inhalation exposures are 5.1×10^{-2} and 3.3×10^{-3} $(mg/kg/day)^{-1}$, respectively. An oral RfD of 1×10^{-2} mg/kg/day has been established based upon a NOAEL of 14 mg/kg/day for liver effects in mice exposed via drinking water for 90 days (Hayes, et al., 1986). OSHA has developed a PEL of 100 ppm TWA, and a 200 ppm CL. NIOSH recommends exposure to PCE be limited to the lowest feasible limit. ACGIH recommend a TLV-TWA of 50 ppm and a TLV-STEL of 200 ppm. The IDLH level is 500 ppm. An AWQC of 0.80 ug/l is associated with a cancer risk level of 10^{-6}. This assumes ingestion of 2L water/day and 6.5 g fish/day. An MCLG of 0 has been proposed. PCE is regulated under CERCLA with a RQ of 1 pound (ATSDR, 1988).

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TRICHLOROETHYLENE

General Data

General Background Information

Trichloroethylene, also known as trichloroethene or TCE, is a colorless liquid at room temperature with an odor similar to ether or chloroform. TCE is commonly used in metal degreasing operations and has been used in dry cleaning procedures, as a chemical intermediate, as a solvent for fats, greases and waxes, for decaffeination purposes, and as a refridgerant and heat exchange liquid. TCE can be found in typewriter correction fluids, paint removers and strippers, adhesives, spot removers, rug cleaning fluids and metal cleaners. (ATSDR 1988, Verschueren, 1983)

Chemical/Physical Properties

Property	Value	Reference
Chemical Formula	C_2HCl_3	U.S. EPA, 1987
Molecular Weight	131	U.S. EPA, 1986
Boiling Point	86.7°C	Verschueren, 1983
Melting Point	-87°C	Verschueren, 1983
Water Solubility	1100 mg/L (20°C)	U.S. EPA, 1986
Vapor Pressure	57.9 mm Hg (20°C)	U.S. EPA, 1986
Henry's Law Constant	9.1 m^3/mole	U.S. EPA, 1986
Koc	126 ml/g	U.S. EPA, 1986
log Kow	2.38	U.S. EPA, 1986

Fate and Transport

Most of the TCE used in the U.S. is released to the atmosphere via volatilization. Major evaporative losses occur during metal degreasing operations, with minor releases resulting from chemical manufacturing. Losses also occur from adhesives, paints, coatings and from landfills and surface waters. Once in the atmosphere, TCE undergoes degradation by reaction with sunlight-produced hydroxyl radicals, producing phosgene, dichloroacetyl chloride, and formyl chloride. TCE photodegrades to chloroform as well (ATSDR, 1987). Photolysis is not a significant process. In surface water and soil, TCE biodegrades slowly, producing dichloroethylene, although small amounts of vinyl chloride may also be formed. Hydrolysis,

oxidation and photolysis are insignificant environmental processes for TCE in water. TCE in groundwater cannot volatilize and may be relatively persistent. There is evidence that slow biodegradation of TCE occurs under anaerobic conditions, and therefore this may occur in subsurface environments (ATSDR, 1988). TCE has a $t_{1/2}$ of 3.7 days in air, 1-4 days in a river, and 30-90 days in a lake (U.S. EPA, 1986). TCE does not bioaccumulate in individual animal food chains (U.S. EPA, 1987).

Toxicity Data

Pharmacokinetics

TCE is lipophilic and is rapidly absorbed following inhalation and ingestion. Determination of dermal absorption rates is complicated by the fact that TCE is lipophilic and can act to defat the skin and disrupt the integrity of the barrier layer, thereby enhancing its own absorption. Significant dermal absorption of TCE may result from direct contact of skin with the liquid, although the rate of absorption appears to be slow (ATSDR, 1988). Tsuruta (1978) found the dermal absorption rate of TCE in mice to be between 7.82 and 12.1 $ug/min/m^2$. TCE is stored in the adipose tissue for relatively long periods of time. TCE also distributes to the brain, lungs and liver (ATSDR, 1988). The major urinary metabolites reported in rats are trichloroacetic acid, trichloroethanol and conjugated trichloroethanol, all of which are produced in the liver (Dekant, et al., 1984).

In humans, TCE has been reported to be extensively metabolized by the liver to trichloroethanol, trichloroethylene-glucuronide and trichloroacetic acid. It has also been hypothesized (Butler, 1949), and recently established that chlorol hydrate (a hypnotic agent) is also a product of TCE metabolism. Unmetabolized TCE is exhaled via the lungs and the metabolities formed by hepatic biotransformation are excreted in the urine (Fernandez, et al., 1975).

Human Toxicological Profile

TCE affects the CNS when inhaled in high concentrations, resulting in effects such as dizziness, headache, slowed reaction times, sleepiness, and facial numbness. Eye, nose and throat irritation occurs at similar concentrations as those producing CNS effects, and the effects are more pronounced after longer exposures. Anorexia, nausea, vomiting and intolerance to fatty foods have been reported after chronic occupational exposure (Grandjean, et al., 1955). Inhalation resulting from acute occupational exposure to high concentrations (lethal) of TCE have produced severe liver damage including necrosis. Hepatic injury has not been associated with longer-term occupational exposure to lower concentrations of TCE. Alcohol consumption reportedly increases the liver's susceptibility to TCE. Renal dysfunction and failure have been described in cases of acute occupational and intentional oral exposure to TCE, although these

reports are infrequent and not quantitative. The use of TCE as an anesthetic was associated with cardiac arrythmias, including bradycardia, atrial and ventricular premature contractions, and ventricular extrasystoles. Epidemiological studies relating TCE exposure to the occurrence of bladder cancers, lymphoma, liver cancer, and cancer of the naso- and oropharynx have been reported, but are of limited usefulness, due to concurrent exposure of subjects to other chemicals, and lack of exposure concentrations (ATSDR, 1988).

Mammalian Toxicology and Significant Studies

The 4 hour inhalation LC_{50} in the rat is reported to be 12,500 ppm (Siegal et al. 1971), and in the mouse it is 7,480 (Lazarev and Gadaskina, 1977). Tucker et al. (1982) report an oral LD_{50} of 2402 mg/kg for male mice and 2443 mg/kg in female mice. Smyth et al. (1969) report an oral LD_{50} in the rat of 4920 mg/kg, and that the dermal LD_{50} in rabbits is greater than 20 ml/kg (28 g/kg).

TCE has produced behavioral changes in rats. Kishi et al. (1986) reported both exposure and duration related decreases in avoidance responses and effective response rates in rats exposed to 250, 500, 1000, 2000 and 4000 ppm TCE for up to 4 hours. Savolainen et al. (1977) reported an increase in open field behavior in rats exposed to 200 ppm TCE 6 hours/day for 4 days. Decreased brain RNA content was observed. TCE has been reported to increase liver weights and plasma butyrylcholinestrase activity in mice exposed to 150 ppm TCE continuously for 30 days (Kjellstrand, et al., 1983). TCE reportedly also causes increased hepatic DNA synthesis activity and hepatic histological alternations characterized by centrilobular swelling with some individual cell necrosis. These effects were observed in mice exposed orally to 2400 mg/kg/day for 3 days or 5 days/week for 3 weeks (Stott et al. 1982).

TCE has also been found to cause renal toxicity in laboratory animals. Kidney weights increased in mice exposed to $\geq$ 75 ppm TCE continuously for 30 days (Kjellstrand, et al. 1981), and in mice exposed for 1 to 16 hours/day to 225 to 3600 ppm for 30 days (Kjellstrand et al. 1983e). Nomiyama et al. (1986) reported that continuous inhalation of 50, 200 or 800 ppm TCE for 12 weeks caused renal dysfunction in rats as indicated by glycosuria, and alterations in plasma creatine, urea, nitrogen, uric acid, and creatine clearance. Chronic nephropathy characterized by degenerative changes in the tubular epithelium occurred in rats exposed orally to 650 and 1300 mg/kg TCE.

Inhalation studies with rats indicate that TCE is fetotoxic but not teratogenic, producing primarily

skeletal ossification anomalies, decreased fetal weight, and other effects consistent with delayed development (ATDSR, 1988). Testis and epididymis weight were decreased in rats at TCE dietary concentrations of $\geq$ 0.15%, and sperm motility was reduced in mice at dietary concentrations of 0.60% in two-generation fertility studies (NTP, 1985, 1986).

TCE containing epichlorohydrin, a carcinogenic epoxide stabilizer, was shown to produce hepatocellular carcinomas in male mice at a TWA dose of 1169 and 2339 mg/kg/day, and in female mice at 2339 mg/kg/day (NCI, 1976). TCE which was epichlorohydrin-free also produced an increased incidence of heptocellular carcinomas in male and female mice at a dose of 1000 mg/kg administered 5 days/week for 103 weeks (NTP, 1982, 1986a). In another study, the NTP (1987) exposed rats to epichlorohydrin-free TCE in olive oil at doses of 0, 500 or 1000 mg/kg, 5 days/week for 103 to 104 weeks. A significant increase in the incidence of renal cell carcinomas in the low dose male Osborne-Mendel rats, and of interstitial cell tumors of the testis in high dose male Marshall rats were reported. Chemically induced toxicity and reduced survival in this study caused the NTP to conclude that the study was invalid. Mice are apparently more susceptible to TCE carcinogenicity than rats. TCE's metabolites trichloroacetic acid and dichloroacetic acid are reportedly complete carcinogens, producing liver tumors in mice, and thus may be involved in TCE's carcinogenicity (ATSDR, 1988).

TCE has been reported to produce immunological changes in mice (Sanders, et al., 1982). Suppressed humoral response to sheep erythrocytes was reported in female CD-1 mice after oral exposure to $\geq$ 437.1 mg/kg/day for 4 months. Suppressed cell-mediated immune response to sheep erythrocytes was reported at $\geq$ 17.9 mg/kg/day after 4 months and at 793.3 mg/kg/day after 6 months in females. Bone marrow stem cell colonization was significantly inhibited in females at $\geq$ 17.9 mg/kg/day after 4 and 6 months, and in males, after 4 months. Female mice are more sensitive than male mice to TCE's immunological toxicity. TCE has also been shown to produce hematological effects in rats and rabbits. In rats exposed to 0, 50, 398 or 796 ppm TCE by inhalation, a dose-related depression of delta-aminolevulinate dehydratase (ALA-D) activity was observed in liver, bone marrow, and erythrocytes, and reportedly was due to an irreversible inhibition of the enzyme. Severe blood dyscrasia, apparently myelotic anemia, was observed in rabbits exposed to 2790 ppm TCE for 4 hr/day, 5 days/week for 45 days (Mazza and Brancaccio, 1967). Dose related changes in hemoglobin, hematocrit, erythrocyte count, reticulocyte count, and erythroblast count were observed in rats exposed to 50, 200, or 800 ppm TCE for 12 weeks (Nomiyama et al., 1988).

TCE has also been reported to produce increased spleen weight, increased respiratory rate, decreased alveolar ventilatory amplitude, cardiac arrythmias, sensitization of the heart to epinephrine-induced arrythmias, and gastrointestinal effects (ATSDR, 1988).

Genotoxicity

Percocco and Prodi (1981) found positive results for unscheduled DNA synthesis both with and without metabolic activation in human lymphocytes in vivo. Gu et al. (1981) found a significant increase in sister chromatid exchange in six workers exposed to TCE. Exposure levels were not provided. Studies of the in vitro genotoxicity of TCE, including gene mutation tests in bacteria, yeasts and molds, are suggestive of a weak positive response. Gene mutation experiments typically required metabolic activation. Recombination in yeast, and cell transformation in animal cells also suggest TCE is genotoxic (ATSDR, 1988).

Regulations and Standards

Trichloroethylene is considered a class B2 carcinogen by the U.S. EPA (U.S. EPA, 1988).

The final Maximum Contaminant Level Goal (MCLG) for trichloroethene is 0 ug/L (EPA, 1990w). This concentration is a non-enforceable concentration that is protective of human health, allowing for an adequate margin of safety. Technical feasibility and cost are not considered in setting MCLGs.

The final Maximum Contaminant Level (MCL) for trichloroethene is 5 ug/L (EPA, 1990w). This concentration is the maximum permissible level of a chemical in water that is delivered to any user of a public water system. When final, the MCL is an enforceable concentration.

The current Threshold Limit Value (TLV) for trichloroethene is 269 mg/m^3 (ACGIH, 1989). The TLVs are developed by the American Conference of Governmental Industrial Hygienists for use in the practice of industrial hygiene. TLVs are eight hour time-weighted average concentrations. They are intended to be interpreted and used by trained industrial hygienists. They are not developed for use as legal standards and they do not apply to situations outside of the workplace.

The current OSHA Permissible Exposure Limit (PEL) for trichloroethene is 540 mg/m^3 (OSHA, 1989). This a Transitional Limit that is applicable until December 30, 1992. The Final PEL is 270 mg/m^3. It is applicable on December 31, 1992. All PELs are eight hour time-weighted average concentrations.

An AWQC of 2.7 ug/l was established for water and fish ingestion, corresponding to a 10^{-6} cancer risk level. U.S. EPA enforces a RQ of 1000 lb. under CERCLA, although a new RQ of 100 lb. has been proposed.

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1,2-DICHLOROETHYLENE (1,2-DCE)

General Data

General Background Information

The 1,2-DCEs are synthetic chemicals with no known natural sources. The production volume for 1,2-DCE (mixed isomers) was 1,000 pounds or less in 1978. The major releases of the 1,2-DCEs in the U.S. are from the manufacturing plants in the Gulf Coast region, where they are used as a captive intermediate in the manufacture of other chlorinated solvents. Such releases are believed to be small. The 1,2-DCEs, especially the cis isomer, have been identified as degradation products of trichloroethylene and tetrachloroethylene in groundwater. The major source of exposure to 1,2-DCEs is from contaminated water, except near production sites, where air exposure may be dominant.

Chemical and Physical Properties

Property	Value	Reference
CAS #	trans: 156-60-5	U.S. EPA, 1984a
	cis: 156-59-2	U.S. EPA, 1984b
Molecular Weight	trans: 96.95	U.S. EPA, 1984b
	cis: 96.95	U.S. EPA, 1984b
Boiling Point	trans: 48°C	Verschueren, 1983
	cis: 60°C	Verschueren, 1983
Melting Point	trans: -50°C	Verschueren, 1983
	cis: -81°C	Verschueren, 1983
Water Solubility	trans: 6300 (mg/l)	U.S. EPA, 1984a
@ 20°C	cis: 3500	U.S. EPA, 1984b
Vapor Pressure	trans: 324 (mm Hg)	U.S. EPA, 1984a
@25°C	cis: 200	U.S. EPA, 1984b
Henry's Law constant	trans: 6.56E-03	U.S. EPA, 1986
	cis: 7.58E-03	U.S. EPA, 1986
K_{oc}	trans: 50	U.S. EPA, 1984a
	cis: 49	U.S. EPA, 1984b
log K_{ow}	trans: 0.48	U.S. EPA, 1984a
	cis: 0.70	U.S. EPA, 1984b

The weighted average bioconcentration factor is 1.6 L/kg (cis and trans), the bioaccumulation potential is low as is the potential for adsorption to soil or sediment. Once released to land, 1,2-DCEs are expected to move with the groundwater. Henry's Law constants are 6.56×10^{-3} (trans) and 7.58×10^{-3} (cis), thus volatilization from aquatic systems occurs readily (EPA, 1986), and appears to be the primary transport process (EPA, 1985).

Fate and Transport

Photooxidation in the troposphere appears to be the dominant environmental fate of trans-1,2-DCE. The compound, when in the troposphere, is attacked at the double bond by hydroxyl radicals, forming formic acid, hydrochloric acid, carbon monoxide, and formaldehyde. Trans-1,2-DCE has a half-life of less than one day in the troposphere. Based on the properties of similar chemicals, photolysis of trans-1,2-DCE in aqueous systems, and photodissociation in the terrestrial environment are probably insignificant (EPA, 1985). 1,2-DCEs have been shown to biodegrade to vinyl chloride in some groundwaters (EPA, 1987).

Toxicity Data

Pharmacokinetics

1,2-DCEs are neutral, low molecular weight, lipid soluble compounds which are expected to be readily absorbed via any route of exposure at levels expected in environmental contamination situations. Distribution data are not available for 1,2-DCEs, but assuming similar behavior as 1,1-DCE, the highest concentrations would be expected in the liver and kidney. The predominant metabolic endpoints of chlorinated ethylenes are alcohols and carboxylic acids. Cis-1,2-DCE yielded dichloroethanol and dichloroacetic acid in an isolated rat liver perfusion study, possibly indicating the initial formation of dichloroacetaldehyde. Trans-1,2-DCE was transformed to 2,2-dichloroethanol and 2,2-dichloroacetic acid in a rat liver microsomal preparation. Presumably these products were formed by reduction or oxidation of 2,2-dichloroacetaldehyde. Trans-1,2-DCE is metabolized at a slower rate than cis-1,2-DCE, indicating that the position of the chlorine may play an important role in metabolism. No data concerning the excretion of 1,2-DCEs are available, but assuming similar behavior as 1,1-DCE, the rate of elimination should be rapid. The majority of a single dose should be excreted in the urine within 24 to 72 hours after cessation of exposure (EPA, 1987 a,b).

Mammalian Toxicology and Significant Studies

The oral LD50 in the rat for the isomer mixture of cis and trans-1,2-DCE was 770 mg/kg. No LD50 value has been reported for the cis isomer only (EPA, 1987a), but for the trans isomer the

oral LD50 in the rat was 1,300 mg/kg. When administered intraperitoneally, the LD50 was 7,800 mg/kg for the trans isomer. Both cis and trans isomers cause general anesthetic and narcotic effects at high doses. At high exposures (8,000 to 16,000 ppm); trans-1,2-DCE can cause narcosis and death in rats within four hours. Administration of a single 400 mg/kg dose of cis-1,2-DCE to rats caused a significant elevation of liver alkaline phosphatase. Male rats exposed by gavage to the trans isomer at 22 or 220 mg/kg for 15 days exhibited no significant immunological effects, nor changes in body or organ weights (EPA, 1987 a,b).

No information was available on the chronic toxicity of cis-1,2-DCE although subchronic and chronic inhalation data were available for trans-1,2-DCE. Wistar rats exposed to trans-1,2-DCE at 200 ppm for 8 hours up to 16 weeks, exhibited slight degenerative changes in the liver along with lipid accumulation. Eight and 16 week exposures produced severe pneumonic infiltration. Exposure to 1000 ppm for 8 hours produced significant hematological changes (EPA, 1987b).

No information was found concerning potential reproductive or developmental toxicity for either isomer. Available data indicate that neither isomer is mutagenic nor genotoxic. Both isomers are considered by the EPA as Group D or not classified as carcinogens, due to inadequate data.

Exposure of humans to high doses of trans-1,2-DCE produced nausea, vomiting, weakness, tremor, and cramps (EPA, 1985). Both isomers produce anesthetic properties in humans, but the trans isomer is reportedly twice as potent as the cis isomer in depressing the central nervous system (EPA, 1987b).

Genotoxicity

Negative results were reported for both isomers of 1,2-DCE using Escherchia coli K12 as the indicator organism, and both isomers were found to be nonmutagenic in Salmonella tester strains (EPA 1984a,b). Cis-1,2-Dichloroethylene was found to induce chromosomal aberrations as indicated by cytogenic analysis of bone marrow cells isolated from mice given repeated intraperitoneal injections, while Trans-1,2-Dichloroethane did not. Cis-1,2-DCE did not increase the recombination rate, frequency of point mutations or gene conversion in Saccharomyces cerevesiae (EPA 1984a,b)

Regulations and Standards

The proposed Maximum Contaminant Level Goal (MCLG) for cis 1,2-DCE is 70 ug/L (U.S. EPA, 1990w). This concentration is a non-enforceable concentration that is protective of human health, allowing for an adquate margin of safety. Technical feasibility and cost are not considered in setting MCLGs.

The proposed Maximum Contaminant Level (MCL) for cis 1,2-DCE is 70 ug/L (U.S. EPA, 1990w). This concentration is the maximum permissible level of a chemical in water that is delivered to any user of a public waste system. When final, the MCL is an enforceable concentration.

The final lifetime Health Advisory for the adult is 70 ug/L for cis 1,2-DCE (U.S. EPA, 1990w). Health Advisories describe nonregulatory concentrations in drinking water at which adverse health effects would not be anticipated to occur over specific exposure durations. Health advisories contain a margin of safety to protect sensitive members of the population. Health Advisories are not legally enforceable Federal standards.

The current Threshold Limit Value (TLV) for cis 1,2-DCE is 793 mg/m^3 (ACGIH, 1989). The TLVs are developed by the American Conference of Governmental Industrial Hygienists for use in the practice of industrial hygiene. TLVs are eight hour time-weighted average concentrations. They are intended to be interpreted and used by trained industrial hygienists. They are not developed for use as legal standards and they do not apply to situations outside of the workplace.

The current OSHA Permissible Exposure Limit (PEL) for cis 1,2-DCE is 790 mg/m^3 (OSHA, 1989). This is a Transitional Limit that is applicable until December 30, 1992. The Final PEL is 790 mg/m^3. It is applicable on December 31, 1992. All PELs are eight hour time-weighted average concentrations.

REFERENCES FOR 1,2-DICHLOROETHYLENE

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VINYL CHLORIDE

General Data

General Background Information

Vinyl chloride is used as a monomer in the production of polyvinyl chloride, the most widely used material in the production of plastics throughout the world. Vinyl chloride is used in building and construction products, electrical wire insulation and cables, industrial and household equipment, medical supplies and packaging for food products. It is also heavily relied upon by the rubber, paper and glass industries (Maltoni, 1976). Vinyl chloride had been used as an aerosol propellant but in 1974 it was banned from use in pesticide aerosol products, in self-pressurized household containers, and as a ingredient of drug and cosmetic products.

Chemical/Physical Properties

Property	Value	Reference
Chemical Formula	CH_2CHCl	Clement, 1985
Molecular Weight	62.5	Clement, 1985
Boiling Point	-13.37°C	Clement, 1985
Melting Point	-153.8°C	Clement, 1985
Water Solubility	2.67 E+03 mg/l	EPA, 1986
Vapor Pressure	2.66 E+03 mm Hg	EPA, 1986
Henry's Law Constant	8.19 E-02 atm-m^3/mol	EPA, 1986
Koc	57 ml/g	EPA, 1986
Log kow	1.38	EPA, 1986

Fate and Transport

Vinyl chloride is a flammable gas at room temperature with a boiling point of -14°C. The most important transport process for distribution of vinyl chloride in the environment is thought to be volatilization from aquatic and terrestrial systems. The half-lives in aquatic media range from a few hours to several months. Studies indicating a low soil adsorption rate and an insignificant biodegradation rate suggest that ground-water contamination is likely (Callahan et al., 1979, Maybe et al., 1981).

Pharmacokinetics

Absorption of vinyl chloride in rats following inhalation or ingestion exposure is rapid whereas absorption by dermal exposure is minor. Once absorbed, vinyl chloride is distributed mainly to the kidney, liver, and spleen and to a lesser degree, to the brain, muscle, and fat. Vinyl chloride is metabolized at low doses and then excreted in the urine. Saturation of the metabolic enzymes occurs at higher concentrations which results in elimination of the parent compound in expired air (EPA, 1980).

Mammalian Toxicology and Significant Studies

A 6000 ppm exposure for 4 hours is the lowest reported lethal concentration for rats (DPIMR, 1981). Central nervous system effects such as narcosis after one minute exposures was observed in mice at 86,000 to 123,000 ppm and in dogs at 170,000 ppm. Cardiac arrhythmias were produced in dogs exposed to 100,000 ppm vinyl chloride for 4 hours (EPA, 1975). Pulmonary edema and hyperemia of the lungs and kidneys are observed in laboratorty animals exposed to 5000 ppm for 1/2 to 1 hour. The reported oral LD_{50} is 50 mg/kg (RTECS, 1979).

Inhalation studies using mice, rats and rabbits indicate that vinyl chloride does not induce gross teratogenic abnormalities in offspring of mothers exposed 4 to 7 hours daily to concentrations ranging from 50 ppm to 6000 ppm (John et al., 1979, Radike et al., 1977). Mice and rats were exposed on days 6 through 15 of gestation in the John et al., (1979) study and on days 9 through 21 in the Radike et al., (1977) study. Rabbits were exposed on days 6 through 18 of gestation.These studies showed a statistically significant increase in the occurrence of minor skeletal abnormalities and an increase in fetal death at higher concentrations. In humans an excess number of central nervous system disorders and deformities of the upper alimentary track, genital organs, and feet were observed in stillborn and live children born in cities with vinyl chloride polymerization plants (Infante, 1981; Infante et al., 1976; Edmonds et al., 1975). These results are somewhat ambiguous and further research is necessary before a positive link between vinyl chloride and the observed effects can be established.

Human Toxicological Profile

Acute occupational exposure to vinyl chloride can produce symptoms of narcosis in humans. Respiratory tract irritation, bronchitis, headache, irritability, dulling of auditory and visual responses, memory disturbances, tingling and weight loss may also occur. Lower doses result in ataxia, congestion and edema of the lungs and hyperemia in the liver (EPA, 1980). Chronic exposure of workers is associated with acro-osteolysis, Raynaud's syndrome,

dermatitis, splenomegaly, thrombocytopenia and liver damage.
Vinyl chloride has been classified as a human carcinogen because of its strong causal association with an increased incidence of liver angiosarcomas as well as tumors of the brain, lung, and hemolymphopoietic system (EPA, 1984). Human data on the carcinogenic effects of vinyl chloride has been collected from occupational settings. Epidemiological studies have focused on liver angiosarcoma because it is an extremely rare liver cancer in humans with only 26 cases reported annually in the United States (NCI, 1976). Chronic inhalation and ingestion of vinyl chloride has induced cancer in the liver and other tissues of rats and mice. These animal data support the findings of epidemiological studies (IARC, 1979).

Genotoxicity

Mutagenic effects of vinyl chloride have been demonstrated using Salmonella typhimurium, Escherichia coli, yeast, germ cells of Drosophila and Chinese Hamster ovary cells. The mutagenic action appears to be dependent upon metabolic conversion to chemically reactive metabolites (EPA, 1980). Following a multiple-exposure regime, vinyl chloride produced chromosome damage in rat bone marrow; human cytogenic studies have yielded inconsistent results (EPA, 1985).

Regulations and Standards

Vinyl chloride has been classified as a Group "A", human carcinogen according to the EPA's criteria for evaluating the overall weight-of-evidence of carcinogenicity to humans (EPA, 1984). Carcinogenic potency factors have been derived by the EPA for inhalation and ingestion routes of exposure. The CSF for vinyl chloride the oral route is 1.9 $(mg/kg/day)^{-1}$ and the CSF is 0.294 $(mg/kg/day)^{-1}$ as calculated from the inhalation unit cancer risk factor (HEAST, 1991). Because vinyl chloride is a human carcinogen, a drinking water maximum contaminant level goal (MCLG) of zero was promulgated and a drinking water MCL of 0.001 mg/l has been proposed (EPA, 1985).

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Appendix D

Risk Assessment Calculations Using Maximum Chemical Concentrations

Risk Assessment Calculations
Carcinogenic Assessment
Subchronic 24 Hour Exposure

Carcinogenic Assessment

Risk By Inhalation and Ingestion Of Chemicals In Air (Highest Detected Concentrations - Subchronic Residential Exposure 24 hours/day)

CHEMICAL-RELATED VARIABLES Chemical	Chemical Concentration In Air (mg/m3 air)	Lung Retention Factor	Inhaled Particle Ingestion Factor	Inhalation Absorption Adjustment Factor	Oral Absorption Adjustment Factor	Inhalation Cancer Slope Factor ((mg/kg-day)^-1)	Oral Cancer Slope Factor ((mg/kg-day)^-1)
Tetrachloroethene	8.21E-02	1	0	1	1	1.82E-03	5.10E-02
Trichloroethene	3.33E-03	1	0	0.35	1	1.70E-02	1.10E-02
trans-1,2-Dichloroethene	3.90E-04	1	0	1	1	ND	ND
cis-1,2-Dichloroethene	4.00E-04	1	0	1	1	ND	ND
Vinyle Chloride	8.00E-04	1	0	1	1	2.94E-01	1.90E+00

```
+---------------------------------------+
|Enter Receptor Names:                  |
|                                       |
|Receptor #1:                           |
|Receptor #2:                           |
|Receptor #3:           Adult           |
+---------------------------------------+


Assumptions for
Carcinogenic Assessment
Risk By Inhalation and Ingestion Of Chemicals In Air (Highest Detected Concentrations  Assumed Value (units)
======================================================================             ===================================
Inhalation Rate                                                                NA (m3 air/day)
Inhalation Rate                                                                NA (m3 air/day)
Inhalation Rate                 Adult                                          15 (m3 air/day)
Body Weight                                                                    70 (kg)
Body Weight                                                                    70 (kg)
Body Weight                     Adult                                          70 (kg)
Exposure Time                                                                  NA (hrs)/24 (hrs) =    0.00E+00
Exposure Time                                                                  NA (hrs)/24 (hrs) =    0.00E+00
Exposure Time                   Adult                                          24 (hrs)/24 (hrs) =    1.00E+00
Exposure Frequency                                                             NA (days)/365 (days) = 0.00E+00
Exposure Frequency                                                             NA (days)/365 (days) = 0.00E+00
Exposure Frequency              Adult                                         350 (days)/365 (days) = 9.59E-01
Exposure Duration                                                              NA (yrs)/ 30 (yrs) =   0.00E+00
Exposure Duration                                                              NA (yrs)/ 30 (yrs) =   0.00E+00
Exposure Duration               Adult                                           1 (yrs)/ 70 (yrs) =   1.43E-02
90th percentile residential                                                    70 (years)
```

Potential Carcinogenic Risk Associated With Potential Inhalation And Ingestion Of Chemicals In Air

The average daily dose (ADD) from inhalation of air is calculated for each receptor using the following equation:

```
      ADDinh =  Chemical       * Inhalation  * Lung         * Exposure     * Exposure       * Inhalation       / Body
  (mg/kg-day) Concentration     Rate          Retention      Time Per       Frequency        Absorption          Weight
                In Air          (m3 air/day)  Factor         24 Hours       Per 365 Days     Adjustment          (kg)
                (mg/m3 air)                                  (hours/hours)  (day/day)        Factor
```

The average daily dose (ADD) from ingestion of entrained particles in air is calculated using the following equation:

```
      ADDing =  Chemical       * Inhalation  * Inhaled      * Exposure     * Exposure       * Oral             / Body
  (mg/kg-day) Concentration     Rate          Particle       Time Per       Frequency        Absorption          Weight
                In Air          (m3 air/day)  Ingestion      24 Hours       Per 365 Days     Adjustment          (kg)
                (mg/m3 air)                   Factor         (hours/hours)  (day/day)        Factor
```

The lifetime average daily dose (LADD) is calculated for each pathway using the following equation, where:

```
Receptor #1 (R1) =
Receptor #2 (R2) =
Receptor #3 (R3) =      Adult



Averaging Time =        AT           Where: AT = Exposure Duration/Lifetime
                                                  (years)         (years)
          LADD =  (ADD,R1 * AT,R1)  +  (ADD,R2 * AT,R2)  +  (ADD,R3 * AT,R3)
     (mg/kg-day) (mg/kg-day)            (mg/kg-day)            (mg/kg-day)
```

The excess lifetime cancer risk associated with inhalation is calculated using the following equation:

```
   Excess Lifetime =  LADDinhalation * Inhalation Cancer Slope Factor
       Cancer Risk    (mg/kg-day)      ((mg/kg-day)^1)
```

The excess lifetime cancer risk associated with ingestion of entrained particles is calculated using the following equation:

```
   Excess Lifetime =  LADDingestion  * Oral Cancer Slope Factor
       Cancer Risk    (mg/kg-day)      ((mg/kg-day)^1)
```

The total excess lifetime cancer risk is calculated using the following equation:

```
       Total Excess = Excess Lifetime Cancer Risk (inhalation) + Excess Lifetime Cancer Risk (ingestion)
Lifetime Cancer Risk
```

Inhalation - Chronic Exposures
Carcinogenic Assessment
Adult

CHEMICAL	Chemical Concentration In Air (mg/m3 air)	Inhalation Rate (m3 air/day)	Lung Retention Factor	Exposure Time Per 24 Hours (hours/hours)	Exposure Frequency Per 365 Days (day/day)	Inhalation Absorption Adjustment Factor	Body Weight (kg)	Average Daily Dose (mg/kg-day)
Tetrachloroethene	8.21E-02	15.0	1	1.00E+00	9.59E-01	1	70	1.69E-02
Trichloroethene	3.33E-03	15.0	1	1.00E+00	9.59E-01	0.35	70	2.39E-04
trans-1,2-Dichloroethene	3.90E-04	15.0	1	1.00E+00	9.59E-01	1	70	8.01E-05
cis-1,2-Dichloroethene	4.00E-04	15.0	1	1.00E+00	9.59E-01	1	70	8.22E-05
Vinyle Chloride	8.00E-04	15.0	1	1.00E+00	9.59E-01	1	70	1.64E-04

POTENTIAL CARCINOGENIC RISK ASSOCIATED WITH INHALATION OF AIR

Average Daily Dose From Potential Inhalation Of Air

CHEMICAL	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	Adult ADDinhalation (mg/kg-day)	Averaging Time Adult (years/years)	Lifetime ADDinhalation (mg/kg-day)	Inhalation Cancer Slope Factor ((mg/kg-day)^-1)	Excess Lifetime Cancer Risk Inhalation
Tetrachloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.69E-02	1.43E-02	2.41E-04	1.82E-03	4.39E-07
Trichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.39E-04	1.43E-02	3.42E-06	1.70E-02	5.82E-08
trans-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.01E-05	1.43E-02	1.14E-06	ND	ND
cis-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.22E-05	1.43E-02	1.17E-06	ND	ND
Vinyle Chloride	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.64E-04	1.43E-02	2.35E-06	2.94E-01	6.90E-07

POTENTIAL CARCINOGENIC RISK ASSOCIATED WITH INHALATION AND INGESTION OF CHEMICALS IN AIR

CHEMICAL	Excess Lifetime Cancer Risk Inhalation	Excess Lifetime Cancer Risk Ingestion	Total Excess Lifetime Cancer Risk
Tetrachloroethene	4.39E-07	0.00E+00	4.39E-07
Trichloroethene	5.82E-08	0.00E+00	5.82E-08
trans-1,2-Dichloroethene	ND	ND	ND
cis-1,2-Dichloroethene	ND	ND	ND
Vinyle Chloride	6.90E-07	0.00E+00	6.90E-07
Total =	1.19E-06	0.00E+00	1.19E-06

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SOURCE: ENSR 1990

Risk Assessment Calculations
Carcinogenic Assessment
Chronic 8 Hour Residential Exposure

Carcinogenic Assessment

Risk By Inhalation and Ingestion Of Chemicals In Air (Highest Detected Concentrations - Chronic Residential Exposure 8 hours/day)

CHEMICAL-RELATED VARIABLES Chemical	Chemical Concentration In Air (mg/m3 air)	Lung Retention Factor	Inhaled Particle Ingestion Factor	Inhalation Absorption Adjustment Factor	Oral Absorption Adjustment Factor	Inhalation Cancer Slope Factor ((mg/kg-day)^-1)	Oral Cancer Slope Factor ((mg/kg-day)^-1)
Tetrachloroethene	8.21E-02	1	0	1	1	1.82E-03	5.10E-02
Trichloroethene	3.33E-03	1	0	0.35	1	1.70E-02	1.10E-02
trans-1,2-Dichloroethene	3.90E-04	1	0	1	1	ND	ND
cis-1,2-Dichloroethene	4.00E-04	1	0	1	1	ND	ND
Vinyle Chloride	8.00E-04	1	0	1	1	2.94E-01	1.90E+00

```
+---------------------------------------+
|Enter Receptor Names:                  |
|                                       |
|Receptor #1:                           |
|Receptor #2:                           |
|Receptor #3:          Adult            |
+---------------------------------------+


Assumptions for
Carcinogenic Assessment
Risk By Inhalation and Ingestion Of Chemicals In Air (Highest Detected Concentrations  Assumed Value (units)
======================================================================        ====================================
Inhalation Rate                                                                      NA (m3 air/day)
Inhalation Rate                                                                      NA (m3 air/day)
Inhalation Rate                  Adult                                               15 (m3 air/day)
Body Weight                                                                          70 (kg)
Body Weight                                                                          70 (kg)
Body Weight                      Adult                                               70 (kg)
Exposure Time                                                                        NA (hrs)/24 (hrs) =    0.00E+00
Exposure Time                                                                        NA (hrs)/24 (hrs) =    0.00E+00
Exposure Time                    Adult                                                8 (hrs)/24 (hrs) =    3.33E-01
Exposure Frequency                                                                   NA (days)/365 (days) = 0.00E+00
Exposure Frequency                                                                   NA (days)/365 (days) = 0.00E+00
Exposure Frequency               Adult                                              350 (days)/365 (days) = 9.59E-01
Exposure Duration                                                                    NA (yrs)/ 30 (yrs) =   0.00E+00
Exposure Duration                                                                    NA (yrs)/ 30 (yrs) =   0.00E+00
Exposure Duration                Adult                                               30 (yrs)/ 70 (yrs) =   4.29E-01
90th percentile residential                                                          70 (years)
```

Potential Carcinogenic Risk Associated With Potential Inhalation And Ingestion Of Chemicals In Air

```
The average daily dose (ADD) from inhalation of air is calculated for each receptor using the following equation:
           ADDinh =  Chemical       * Inhalation    * Lung          * Exposure     * Exposure     * Inhalation          / Body
        (mg/kg-day) Concentration     Rate            Retention       Time Per       Frequency      Absorption            Weight
                     In Air           (m3 air/day)    Factor          24 Hours       Per 365 Days   Adjustment            (kg)
                     (mg/m3 air)                                      (hours/hours)  (day/day)      Factor

The average daily dose (ADD) from ingestion of entrained particles in air is calculated using the following equation:
           ADDing =  Chemical       * Inhalation    * Inhaled       * Exposure     * Exposure     * Oral                / Body
        (mg/kg-day) Concentration     Rate            Particle        Time Per       Frequency      Absorption            Weight
                     In Air           (m3 air/day)    Ingestion       24 Hours       Per 365 Days   Adjustment            (kg)
                     (mg/m3 air)                      Factor          (hours/hours)  (day/day)      Factor

The lifetime average daily dose (LADD) is calculated for each pathway using the following equation, where:

Receptor #1 (R1) =
Receptor #2 (R2) =
Receptor #3 (R3) =   Adult



Averaging Time =     AT           Where: AT = Exposure Duration/Lifetime
                                                 (years)        (years)
             LADD =  (ADD,R1 * AT,R1)  +  (ADD,R2 * AT,R2)  +  (ADD,R3 * AT,R3)
        (mg/kg-day) (mg/kg-day)          (mg/kg-day)          (mg/kg-day)

The excess lifetime cancer risk associated with inhalation is calculated using the following equation:
    Excess Lifetime =  LADDinhalation * Inhalation Cancer Slope Factor
       Cancer Risk     (mg/kg-day)      ((mg/kg-day)^1)

The excess lifetime cancer risk associated with ingestion of entrained particles is calculated using the following equation:
    Excess Lifetime =  LADDingestion  * Oral Cancer Slope Factor
       Cancer Risk     (mg/kg-day)      ((mg/kg-day)^1)

The total excess lifetime cancer risk is calculated using the following equation:
       Total Excess = Excess Lifetime Cancer Risk (inhalation) + Excess Lifetime Cancer Risk (ingestion)
Lifetime Cancer Risk
```

Inhalation - Chronic Exposures
Carcinogenic Assessment
Adult

CHEMICAL	Chemical Concentration In Air (mg/m3 air)	Inhalation Rate (m3 air/day)	Lung Retention Factor	Exposure Time Per 24 Hours (hours/hours)	Exposure Frequency Per 365 Days (day/day)	Inhalation Absorption Adjustment Factor	Body Weight (kg)	Average Daily Dose (mg/kg-day)
Tetrachloroethene	8.21E-02	15.0	1	3.33E-01	9.59E-01	1	70	5.62E-03
Trichloroethene	3.33E-03	15.0	1	3.33E-01	9.59E-01	0.35	70	7.98E-05
trans-1,2-Dichloroethene	3.90E-04	15.0	1	3.33E-01	9.59E-01	1	70	2.67E-05
cis-1,2-Dichloroethene	4.00E-04	15.0	1	3.33E-01	9.59E-01	1	70	2.74E-05
Vinyle Chloride	8.00E-04	15.0	1	3.33E-01	9.59E-01	1	70	5.48E-05

POTENTIAL CARCINOGENIC RISK ASSOCIATED WITH INHALATION OF AIR

Average Daily Dose From Potential Inhalation Of Air

CHEMICAL	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	Adult ADDinhalation (mg/kg-day)	Averaging Time Adult (years/years)	Lifetime ADDinhalation (mg/kg-day)	Inhalation Cancer Slope Factor ((mg/kg-day)^-1)	Excess Lifetime Cancer Risk Inhalation
Tetrachloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.62E-03	4.29E-01	2.41E-03	1.82E-03	4.39E-06
Trichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.98E-05	4.29E-01	3.42E-05	1.70E-02	5.82E-07
trans-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.67E-05	4.29E-01	1.14E-05	ND	ND
cis-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.74E-05	4.29E-01	1.17E-05	ND	ND
Vinyle Chloride	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.48E-05	4.29E-01	2.35E-05	2.94E-01	6.90E-06

POTENTIAL CARCINOGENIC RISK ASSOCIATED WITH INHALATION AND INGESTION OF CHEMICALS IN AIR

CHEMICAL	Excess Lifetime Cancer Risk Inhalation	Excess Lifetime Cancer Risk Ingestion	Total Excess Lifetime Cancer Risk
Tetrachloroethene	4.39E-06	0.00E+00	4.39E-06
Trichloroethene	5.82E-07	0.00E+00	5.82E-07
trans-1,2-Dichloroethene	ND	ND	ND
cis-1,2-Dichloroethene	ND	ND	ND
Vinyle Chloride	6.90E-06	0.00E+00	6.90E-06
Total =	1.19E-05	0.00E+00	1.19E-05

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SOURCE: ENSR 1990

Risk Assessment Calculations
Carcinogenic Assessment
Chronic 12 Hour Residential Exposure

Carcinogenic Assessment

Risk By Inhalation and Ingestion Of Chemicals In Air (Highest Detected Concentrations - Chronic Residential Exposure 12 hours/day)

CHEMICAL-RELATED VARIABLES Chemical	Chemical Concentration In Air (mg/m3 air)	Lung Retention Factor	Inhaled Particle Ingestion Factor	Inhalation Absorption Adjustment Factor	Oral Absorption Adjustment Factor	Inhalation Cancer Slope Factor ((mg/kg-day)^-1)	Oral Cancer Slope Factor ((mg/kg-day)^-1)
Tetrachloroethene	8.21E-02	1	0	1	1	1.82E-03	5.10E-02
Trichloroethene	3.33E-03	1	0	0.35	1	1.70E-02	1.10E-02
trans-1,2-Dichloroethene	3.90E-04	1	0	1	1	ND	ND
cis-1,2-Dichloroethene	4.00E-04	1	0	1	1	ND	ND
Vinyle Chloride	8.00E-04	1	0	1	1	2.94E-01	1.90E+00

```
+-------------------------------------+
|Enter Receptor Names:                |
|                                     |
|Receptor #1:                         |
|Receptor #2:                         |
|Receptor #3:           Adult         |
+-------------------------------------+


Assumptions for
Carcinogenic Assessment
Risk By Inhalation and Ingestion Of Chemicals In Air (Highest Detected Concentrations  Assumed Value (units)
======================================================================          ====================================
Inhalation Rate                                                    NA (m3 air/day)
Inhalation Rate                                                    NA (m3 air/day)
Inhalation Rate                 Adult                              15 (m3 air/day)
Body Weight                                                        70 (kg)
Body Weight                                                        70 (kg)
Body Weight                     Adult                              70 (kg)
Exposure Time                                                      NA (hrs)/24 (hrs) =    0.00E+00
Exposure Time                                                      NA (hrs)/24 (hrs) =    0.00E+00
Exposure Time                   Adult                              12 (hrs)/24 (hrs) =    5.00E-01
Exposure Frequency                                                 NA (days)/365 (days) = 0.00E+00
Exposure Frequency                                                 NA (days)/365 (days) = 0.00E+00
Exposure Frequency              Adult                             350 (days)/365 (days) = 9.59E-01
Exposure Duration                                                  NA (yrs)/ 30 (yrs) =   0.00E+00
Exposure Duration                                                  NA (yrs)/ 30 (yrs) =   0.00E+00
Exposure Duration               Adult                              30 (yrs)/ 70 (yrs) =   4.29E-01
90th percentile residential                                        70 (years)
```

Potential Carcinogenic Risk Associated With Potential Inhalation And Ingestion Of Chemicals In Air

The average daily dose (ADD) from inhalation of air is calculated for each receptor using the following equation:

```
        ADDinh =  Chemical       * Inhalation    * Lung         * Exposure     * Exposure      * Inhalation        / Body
    (mg/kg-day) Concentration      Rate            Retention      Time Per       Frequency       Absorption          Weight
                  In Air           (m3 air/day)    Factor         24 Hours       Per 365 Days    Adjustment          (kg)
                  (mg/m3 air)                                     (hours/hours)  (day/day)       Factor
```

The average daily dose (ADD) from ingestion of entrained particles in air is calculated using the following equation:

```
        ADDing =  Chemical       * Inhalation    * Inhaled      * Exposure     * Exposure      * Oral              / Body
    (mg/kg-day) Concentration      Rate            Particle       Time Per       Frequency       Absorption          Weight
                  In Air           (m3 air/day)    Ingestion      24 Hours       Per 365 Days    Adjustment          (kg)
                  (mg/m3 air)                      Factor         (hours/hours)  (day/day)       Factor
```

The lifetime average daily dose (LADD) is calculated for each pathway using the following equation, where:

```
Receptor #1 (R1) =
Receptor #2 (R2) =
Receptor #3 (R3) =      Adult



Averaging Time =        AT             Where: AT = Exposure Duration/Lifetime
                                                     (years)        (years)
          LADD =  (ADD,R1 * AT,R1)  +  (ADD,R2 * AT,R2)  +  (ADD,R3 * AT,R3)
    (mg/kg-day) (mg/kg-day)          (mg/kg-day)          (mg/kg-day)
```

The excess lifetime cancer risk associated with inhalation is calculated using the following equation:

```
     Excess Lifetime =  LADDinhalation * Inhalation Cancer Slope Factor
         Cancer Risk    (mg/kg-day)      ((mg/kg-day)^1)
```

The excess lifetime cancer risk associated with ingestion of entrained particles is calculated using the following equation:

```
     Excess Lifetime =  LADDingestion  * Oral Cancer Slope Factor
         Cancer Risk    (mg/kg-day)      ((mg/kg-day)^1)
```

The total excess lifetime cancer risk is calculated using the following equation:

```
         Total Excess = Excess Lifetime Cancer Risk (inhalation) + Excess Lifetime Cancer Risk (ingestion)
Lifetime Cancer Risk
```

Inhalation - Chronic Exposures
Carcinogenic Assessment
Adult

CHEMICAL	Chemical Concentration In Air (mg/m3 air)	Inhalation Rate (m3 air/day)	Lung Retention Factor	Exposure Time Per 24 Hours (hours/hours)	Exposure Frequency Per 365 Days (day/day)	Inhalation Absorption Adjustment Factor	Body Weight (kg)	Average Daily Dose (mg/kg-day)
Tetrachloroethene	8.21E-02	15.0	1	5.00E-01	9.59E-01	1	70	8.43E-03
Trichloroethene	3.33E-03	15.0	1	5.00E-01	9.59E-01	0.35	70	1.20E-04
trans-1,2-Dichloroethene	3.90E-04	15.0	1	5.00E-01	9.59E-01	1	70	4.01E-05
cis-1,2-Dichloroethene	4.00E-04	15.0	1	5.00E-01	9.59E-01	1	70	4.11E-05
Vinyle Chloride	8.00E-04	15.0	1	5.00E-01	9.59E-01	1	70	8.22E-05

POTENTIAL CARCINOGENIC RISK ASSOCIATED WITH INHALATION OF AIR

Average Daily Dose From Potential Inhalation Of Air

CHEMICAL	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	Adult ADDinhalation (mg/kg-day)	Averaging Time Adult (years/years)	Lifetime ADDinhalation (mg/kg-day)	Inhalation Cancer Slope Factor ((mg/kg-day)^-1)	Excess Lifetime Cancer Risk Inhalation
Tetrachloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.43E-03	4.29E-01	3.61E-03	1.82E-03	6.58E-06
Trichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.20E-04	4.29E-01	5.13E-05	1.70E-02	8.72E-07
trans-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.01E-05	4.29E-01	1.72E-05	ND	ND
cis-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.11E-05	4.29E-01	1.76E-05	ND	ND
Vinyle Chloride	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.22E-05	4.29E-01	3.52E-05	2.94E-01	1.04E-05

POTENTIAL CARCINOGENIC RISK ASSOCIATED WITH INHALATION AND INGESTION OF CHEMICALS IN AIR

CHEMICAL	Excess Lifetime Cancer Risk Inhalation	Excess Lifetime Cancer Risk Ingestion	Total Excess Lifetime Cancer Risk
Tetrachloroethene	6.58E-06	0.00E+00	6.58E-06
Trichloroethene	8.72E-07	0.00E+00	8.72E-07
trans-1,2-Dichloroethene	ND	ND	ND
cis-1,2-Dichloroethene	ND	ND	ND
Vinyle Chloride	1.04E-05	0.00E+00	1.04E-05
Total =	1.78E-05	0.00E+00	1.78E-05

CRC12.WQ1 25-Mar-92 R.N.: 00

SOURCE: ENSR 1990

Risk Assessment Calculations
Noncarcinogenic Assessment
Subchronic 24 Hour Exposure

Envirocon

Noncarcinogenic Assessment

Exposure By Inhalation and Ingestion Of Chemicals In Air (Subchronic)

CHEMICAL-RELATED VARIABLES Chemical	Chemical Concentration In Air (mg/m3 air)	Lung Retention Factor	Inhaled Particle Ingestion Factor	Inhalation Absorption Adjustment Factor	Oral Absorption Adjustment Factor	Inhalation Reference Dose (mg/kg-day)	Oral Reference Dose (mg/kg-day)
Tetrachloroethene	8.21E-02	1	0	1	1	1.00E-01	1.00E-01
Trichloroethene	3.33E-03	1	0	0.35	1	ND	ND
trans-1,2-Dichloroethene	3.90E-04	1	0	1	1	2.00E-01	2.00E-01
cis-1,2-Dichloroethene	4.00E-04	1	0	1	1	1.00E-01	1.00E-01
Vinyle Chloride	8.00E-04	1	0	1	1	ND	ND

```
+---------------------------------------+
|Enter Receptor Names:                  |
|                                       |
|Receptor #1:                           |
|Receptor #2:                           |
|Receptor #3:           Adult           |
+---------------------------------------+


Assumptions for
Noncarcinogenic Assessment
Exposure By Inhalation and Ingestion Of Chemicals In Air (Subchronic)          Assumed Value   (units)
======================================================================         ================================
Inhalation Rate                                                                           NA (m3 air/day)
Inhalation Rate                                                                           NA (m3 air/day)
Inhalation Rate                    Adult                                                  15 (m3 air/day)
Body Weight                                                                               70 (kg)
Body Weight                                                                               70 (kg)
Body Weight                        Adult                                                  70 (kg)
Exposure Time                                                                             NA (hrs)/24 hrs) =  0.00E+00
Exposure Time                                                                             NA (hrs)/24 hrs) =  0.00E+00
Exposure Time                      Adult                                                  24 (hrs)/24 hrs) =  1.00E+00
Exposure Frequency                                                                        NA (days)/365 days =0.00E+00
Exposure Frequency                                                                        NA (days)/365 days =0.00E+00
Exposure Frequency                 Adult                                                 350 (days)/365 days =9.59E-01
Exposure Duration                                                                         NA (yrs)/69 (yrs) = 0.00E+00
Exposure Duration                                                                         NA (yrs)/69 (yrs) = 0.00E+00
Exposure Duration                  Adult                                                   1 (yrs)/69 (yrs) = 1.00E+00
Total Exposure Duration                                                                    1 (years)
```

Potential Noncarcinogenic Hazard Index Associated With Potential Inhalation And Ingestion Of Chemicals In Air

```
The average daily dose (ADD) from inhalation of air is calculated for each receptor using the following equation:
        ADDinh =  Chemical        * Inhalation    * Lung          * Exposure        * Exposure       * Inhalation     / Body
     (mg/kg-day)  Concentration     Rate            Retention       Time Per          Frequency        Absorption       Weight
                  In Air            (m3 air/day)    Factor          24 Hours          Per 365 Days     Adjustment       (kg)
                  (mg/m3 air)                                       (hours/hours)     (day/day)        Factor

The average daily dose (ADD) from ingestion of entrained particles in air is calculated using the following equation:
        ADDing =  Chemical        * Inhalation    * Inhaled       * Exposure        * Exposure       * Oral           / Body
     (mg/kg-day)  Concentration     Rate            Particle        Time Per          Frequency        Absorption       Weight
                  In Air            (m3 air/day)    Ingestion       24 Hours          Per 365 Days     Adjustment       (kg)
                  (mg/m3 air)                       Factor          (hours/hours)     (day/day)        Factor

The chronic average daily dose (CADD) is calculated for each pathway using the following equation, where:

Receptor #1 (R1) =
Receptor #2 (R2) =
Receptor #3 (R3) =      Adult

.

Averaging Time =        AT              Where: AT = Exposure Duration/Total Exposure Duration
                                                     (year)          (year)
          CADD =  (ADD,R1 * AT,R1)  +  (ADD,R2 * AT,R2)  +  (ADD,R3 * AT,R3)
     (mg/kg-day)  (mg/kg-day)          (mg/kg-day)          (mg/kg-day)

The hazard index associated with inhalation is calculated using the following equation:
    Hazard Index =  CADDInhalation  / Inhalation RfD
      inhalation    (mg/kg-day)       (mg/kg-day)

The hazard index associated with ingestion of entrained particles is calculated using the following equation:
    Hazard Index =  CADDIngestion   / Oral RfD
       ingestion    (mg/kg-day)       (mg/kg-day)

The total hazard index is calculated using the following equation:
           Total =  Hazard Index    + Hazard Index
    Hazard Index    Inhalation        Ingestion
```

Inhalation - Chronic Exposures
Noncarcinogenic Assessment
Adult

CHEMICAL	Chemical Concentration In Air (mg/m3 air)	Inhalation Rate (m3 air/day)	Lung Retention Factor	Exposure Time Per 24 Hours (hours/hours)	Exposure Frequency Per 365 Days (day/day)	Inhalation Absorption Adjustment Factor	Body Weight (kg)	Average Daily Dose (mg/kg-day)
Tetrachloroethene	8.21E-02	15.0	1	1.00E+00	9.59E-01	1	70	1.69E-02
Trichloroethene	3.33E-03	15.0	1	1.00E+00	9.59E-01	0.35	70	2.39E-04
trans-1,2-Dichloroethene	3.90E-04	15.0	1	1.00E+00	9.59E-01	1	70	8.01E-05
cis-1,2-Dichloroethene	4.00E-04	15.0	1	1.00E+00	9.59E-01	1	70	8.22E-05
Vinyle Chloride	8.00E-04	15.0	1	1.00E+00	9.59E-01	1	70	1.64E-04

POTENTIAL NONCARCINOGENIC HAZARD INDEX ASSOCIATED WITH INHALATION OF AIR

Average Daily Dose From Potential Inhalation Of Air

CHEMICAL	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	Adult ADDinhalation (mg/kg-day)	Averaging Time Adult (years/years)	Chronic ADDinhalation (mg/kg-day)	Inhalation Reference Dose (mg/kg-day)	Hazard Index Inhalation
Tetrachloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.69E-02	1.00E+00	1.69E-02	1.00E-01	1.69E-01
Trichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.39E-04	1.00E+00	2.39E-04	ND	ND
trans-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.01E-05	1.00E+00	8.01E-05	2.00E-01	4.01E-04
cis-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.22E-05	1.00E+00	8.22E-05	1.00E-01	8.22E-04
Vinyle Chloride	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.64E-04	1.00E+00	1.64E-04	ND	ND

POTENTIAL NONCARCINOGENIC HAZARD INDEX ASSOCIATED WITH INHALATION AND INGESTION OF CHEMICALS IN AIR

CHEMICAL	Hazard Index Inhalation	Hazard Index Ingestion	Total Hazard Index
Tetrachloroethene	1.69E-01	0.00E+00	1.69E-01
Trichloroethene	ND	ND	ND
trans-1,2-Dichloroethene	4.01E-04	0.00E+00	4.01E-04
cis-1,2-Dichloroethene	8.22E-04	0.00E+00	8.22E-04
Vinyle Chloride	ND	N.D.	N.D.
Total =	1.70E-01	0.00E+00	1.70E-01

SUBCHRONIC.WQ1 24-Mar-92 R.N.: 03

SOURCE: ENSR 1990

Risk Assessment Calculations
Noncarcinogenic Assessment
Chronic 8 Hour Residential Exposure

Noncarcinogenic Assessment
Exposure By Inhalation and Ingestion Of Chemicals In Air (Chronic Residential Exposure 8 hours/day)

CHEMICAL-RELATED VARIABLES Chemical	Chemical Concentration In Air (mg/m3 air)	Lung Retention Factor	Inhaled Particle Ingestion Factor	Inhalation Absorption Adjustment Factor	Oral Absorption Adjustment Factor	Inhalation Reference Dose (mg/kg-day)	Oral Reference Dose (mg/kg-day)
Tetrachloroethene	8.21E-02	1	0	1	1	1.00E-02	1.00E-02
Trichloroethene	3.33E-03	1	0	0.35	1	ND	ND
trans-1,2-Dichloroethene	3.90E-04	1	0	1	1	2.00E-02	2.00E-02
cis-1,2-Dichloroethene	4.00E-04	1	0	1	1	1.00E-02	1.00E-02
Vinyle Chloride	8.00E-04	1	0	1	1	ND	ND

```
+----------------------------------------+
|Enter Receptor Names:                   |
|                                        |
|Receptor #1:                            |
|Receptor #2:                            |
|Receptor #3:           Adult            |
+----------------------------------------+


Assumptions for
Noncarcinogenic Assessment
Exposure By Inhalation and Ingestion Of Chemicals In Air (Chronic Residential Exposure 8 hAssumed Value   (units)
========================================================================                  =================================
Inhalation Rate                                                                                      NA (m3 air/day)
Inhalation Rate                                                                                      NA (m3 air/day)
Inhalation Rate                   Adult                                                              15 (m3 air/day)
Body Weight                                                                                          70 (kg)
Body Weight                                                                                          70 (kg)
Body Weight                       Adult                                                              70 (kg)
Exposure Time                                                                                        NA (hrs)/24 hrs) =  0.00E+00
Exposure Time                                                                                        NA (hrs)/24 hrs) =  0.00E+00
Exposure Time                     Adult                                                               8 (hrs)/24 hrs) =  3.33E-01
Exposure Frequency                                                                                   NA (days)/365 days =0.00E+00
Exposure Frequency                                                                                   NA (days)/365 days =0.00E+00
Exposure Frequency                Adult                                                             350 (days)/365 days =9.59E-01
Exposure Duration                                                                                    NA (yrs)/69 (yrs) = 0.00E+00
Exposure Duration                                                                                    NA (yrs)/69 (yrs) = 0.00E+00
Exposure Duration                 Adult                                                              30 (yrs)/69 (yrs) = 1.00E+00
Total Exposure Duration                                                                              30 (years)
```

```
                    Potential Noncarcinogenic Hazard Index Associated With Potential Inhalation And Ingestion Of Chemicals In Air


The average daily dose (ADD) from inhalation of air is calculated for each receptor using the following equation:
            ADDinh =  Chemical        * Inhalation    * Lung          * Exposure        * Exposure       * Inhalation     / Body
          (mg/kg-day) Concentration     Rate            Retention       Time Per          Frequency        Absorption       Weight
                      In Air            (m3 air/day)    Factor          24 Hours          Per 365 Days     Adjustment       (kg)
                      (mg/m3 air)                                       (hours/hours)     (day/day)        Factor

The average daily dose (ADD) from ingestion of entrained particles in air is calculated using the following equation:
            ADDing =  Chemical        * Inhalation    * Inhaled       * Exposure        * Exposure       * Oral           / Body
          (mg/kg-day) Concentration     Rate            Particle        Time Per          Frequency        Absorption       Weight
                      In Air            (m3 air/day)    Ingestion       24 Hours          Per 365 Days     Adjustment       (kg)
                      (mg/m3 air)                       Factor          (hours/hours)     (day/day)        Factor

The chronic average daily dose (CADD) is calculated for each pathway using the following equation, where:

Receptor #1 (R1) =
Receptor #2 (R2) =
Receptor #3 (R3) =    Adult




Averaging Time =      AT              Where: AT = Exposure Duration/Total Exposure Duration
                                                       (year)         (year)
             CADD =   (ADD,R1 * AT,R1)  +  (ADD,R2 * AT,R2)  +  (ADD,R3 * AT,R3)
          (mg/kg-day) (mg/kg-day)          (mg/kg-day)          (mg/kg-day)

The hazard index associated with inhalation is calculated using the following equation:
       Hazard Index = CADDInhalation  / Inhalation RfD
         inhalation   (mg/kg-day)       (mg/kg-day)

The hazard index associated with ingestion of entrained particles is calculated using the following equation:
       Hazard Index = CADDIngestion   / Oral RfD
          ingestion   (mg/kg-day)       (mg/kg-day)

The total hazard index is calculated using the following equation:
              Total = Hazard Index    + Hazard Index
       Hazard Index   Inhalation        Ingestion
```

Inhalation - Chronic Exposures
Noncarcinogenic Assessment
Adult

CHEMICAL	Chemical Concentration In Air (mg/m3 air)	Inhalation Rate (m3 air/day)	Lung Retention Factor	Exposure Time Per 24 Hours (hours/hours)	Exposure Frequency Per 365 Days (day/day)	Inhalation Absorption Adjustment Factor	Body Weight (kg)	Average Daily Dose (mg/kg-day)
Tetrachloroethene	8.21E-02	15.0	1	3.33E-01	9.59E-01	1	70	5.62E-03
Trichloroethene	3.33E-03	15.0	1	3.33E-01	9.59E-01	0.35	70	7.98E-05
trans-1,2-Dichloroethene	3.90E-04	15.0	1	3.33E-01	9.59E-01	1	70	2.67E-05
cis-1,2-Dichloroethene	4.00E-04	15.0	1	3.33E-01	9.59E-01	1	70	2.74E-05
Vinyle Chloride	8.00E-04	15.0	1	3.33E-01	9.59E-01	1	70	5.48E-05

POTENTIAL NONCARCINOGENIC HAZARD INDEX ASSOCIATED WITH INHALATION OF AIR

Average Daily Dose From Potential Inhalation Of Air

CHEMICAL	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	Adult ADDinhalation (mg/kg-day)	Averaging Time Adult (years/years)	Chronic ADDinhalation (mg/kg-day)	Inhalation Reference Dose (mg/kg-day)	Hazard Index Inhalation
Tetrachloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.62E-03	1.00E+00	5.62E-03	1.00E-02	5.62E-01
Trichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.98E-05	1.00E+00	7.98E-05	ND	ND
trans-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.67E-05	1.00E+00	2.67E-05	2.00E-02	1.34E-03
cis-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.74E-05	1.00E+00	2.74E-05	1.00E-02	2.74E-03
Vinyle Chloride	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.48E-05	1.00E+00	5.48E-05	ND	ND

POTENTIAL NONCARCINOGENIC HAZARD INDEX ASSOCIATED WITH INHALATION AND INGESTION OF CHEMICALS IN AIR

CHEMICAL	Hazard Index Inhalation	Hazard Index Ingestion	Total Hazard Index
Tetrachloroethene	5.62E-01	0.00E+00	5.62E-01
Trichloroethene	ND	0.00E+00	NA
trans-1,2-Dichloroethene	1.34E-03	0.00E+00	1.34E-03
cis-1,2-Dichloroethene	2.74E-03	0.00E+00	2.74E-03
Vinyle Chloride	ND	N.D.	N.D.
Total =	5.66E-01	0.00E+00	5.66E-01

CHRONIC8.WQ1 24-Mar-92 R.N.: 02

SOURCE: ENSR 1990

Risk Assessment Calculations
Noncarcinogenic Assessment
Chronic 12 Hour Residential Exposure

Noncarcinogenic Assessment
Exposure By Inhalation and Ingestion Of Chemicals In Air (Chronic Residential Exposure 12 hours/day)

CHEMICAL-RELATED VARIABLES Chemical	Chemical Concentration In Air (mg/m3 air)	Lung Retention Factor	Inhaled Particle Ingestion Factor	Inhalation Absorption Adjustment Factor	Oral Absorption Adjustment Factor	Inhalation Reference Dose (mg/kg-day)	Oral Reference Dose (mg/kg-day)
Tetrachloroethene	8.21E-02	1	0	1	1	1.00E-02	1.00E-02
Trichloroethene	3.33E-03	1	0	0.35	1	ND	ND
trans-1,2-Dichloroethene	3.90E-04	1	0	1	1	2.00E-02	2.00E-02
cis-1,2-Dichloroethene	4.00E-04	1	0	1	1	1.00E-02	1.00E-02
Vinyle Chloride	8.00E-04	1	0	1	1	ND	ND

```
+----------------------------------------+
|Enter Receptor Names:                   |
|                                        |
|Receptor #1:                            |
|Receptor #2:                            |
|Receptor #3:          Adult             |
+----------------------------------------+


Assumptions for
Noncarcinogenic Assessment
Exposure By Inhalation and Ingestion Of Chemicals In Air (Chronic Residential Exposure 12 Assumed Value   (units)
========================================================================          =================================
Inhalation Rate                                                                         NA (m3 air/day)
Inhalation Rate                                                                         NA (m3 air/day)
Inhalation Rate                  Adult                                                  15 (m3 air/day)
Body Weight                                                                             70 (kg)
Body Weight                                                                             70 (kg)
Body Weight                      Adult                                                  70 (kg)
Exposure Time                                                                           NA (hrs)/24 hrs) =  0.00E+00
Exposure Time                                                                           NA (hrs)/24 hrs) =  0.00E+00
Exposure Time                    Adult                                                  12 (hrs)/24 hrs) =  5.00E-01
Exposure Frequency                                                                      NA (days)/365 days =0.00E+00
Exposure Frequency                                                                      NA (days)/365 days =0.00E+00
Exposure Frequency               Adult                                                 350 (days)/365 days =9.59E-01
Exposure Duration                                                                       NA (yrs)/69 (yrs) = 0.00E+00
Exposure Duration                                                                       NA (yrs)/69 (yrs) = 0.00E+00
Exposure Duration                Adult                                                  30 (yrs)/69 (yrs) = 1.00E+00
Total Exposure Duration                                                                 30 (years)
```

Potential Noncarcinogenic Hazard Index Associated With Potential Inhalation And Ingestion Of Chemicals In Air

The average daily dose (ADD) from inhalation of air is calculated for each receptor using the following equation:

```
        ADDinh = Chemical        * Inhalation   * Lung         * Exposure       * Exposure       * Inhalation    / Body
   (mg/kg-day) Concentration       Rate           Retention      Time Per         Frequency        Absorption      Weight
               In Air              (m3 air/day)   Factor         24 Hours         Per 365 Days     Adjustment      (kg)
               (mg/m3 air)                                       (hours/hours)    (day/day)        Factor
```

The average daily dose (ADD) from ingestion of entrained particles in air is calculated using the following equation:

```
        ADDing = Chemical        * Inhalation   * Inhaled      * Exposure       * Exposure       * Oral          / Body
   (mg/kg-day) Concentration       Rate           Particle       Time Per         Frequency        Absorption      Weight
               In Air              (m3 air/day)   Ingestion      24 Hours         Per 365 Days     Adjustment      (kg)
               (mg/m3 air)                        Factor         (hours/hours)    (day/day)        Factor
```

The chronic average daily dose (CADD) is calculated for each pathway using the following equation, where:

```
Receptor #1 (R1) =
Receptor #2 (R2) =
Receptor #3 (R3) =     Adult
```

```
Averaging Time =       AT             Where: AT = Exposure Duration/Total Exposure Duration
                                                    (year)          (year)
          CADD = (ADD,R1 * AT,R1)  +  (ADD,R2 * AT,R2)  +  (ADD,R3 * AT,R3)
   (mg/kg-day) (mg/kg-day)            (mg/kg-day)          (mg/kg-day)
```

The hazard index associated with inhalation is calculated using the following equation:

```
      Hazard Index =  CADDInhalation  / Inhalation RfD
        inhalation    (mg/kg-day)       (mg/kg-day)
```

The hazard index associated with ingestion of entrained particles is calculated using the following equation:

```
      Hazard Index =  CADDIngestion   / Oral RfD
         ingestion    (mg/kg-day)       (mg/kg-day)
```

The total hazard index is calculated using the following equation:

```
           Total =  Hazard Index    + Hazard Index
      Hazard Index  Inhalation        Ingestion
```

Inhalation - Chronic Exposures
Noncarcinogenic Assessment
Adult

CHEMICAL	Chemical Concentration In Air (mg/m3 air)	Inhalation Rate (m3 air/day)	Lung Retention Factor	Exposure Time Per 24 Hours (hours/hours)	Exposure Frequency Per 365 Days (day/day)	Inhalation Absorption Adjustment Factor	Body Weight (kg)	Average Daily Dose (mg/kg-day)
Tetrachloroethene	8.21E-02	15.0	1	5.00E-01	9.59E-01	1	70	8.43E-03
Trichloroethene	3.33E-03	15.0	1	5.00E-01	9.59E-01	0.35	70	1.20E-04
trans-1,2-Dichloroethene	3.90E-04	15.0	1	5.00E-01	9.59E-01	1	70	4.01E-05
cis-1,2-Dichloroethene	4.00E-04	15.0	1	5.00E-01	9.59E-01	1	70	4.11E-05
Vinyle Chloride	8.00E-04	15.0	1	5.00E-01	9.59E-01	1	70	8.22E-05

POTENTIAL NONCARCINOGENIC HAZARD INDEX ASSOCIATED WITH INHALATION OF AIR

Average Daily Dose From Potential Inhalation Of Air

CHEMICAL	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	Adult ADDinhalation (mg/kg-day)	Averaging Time Adult (years/years)	Chronic ADDinhalation (mg/kg-day)	Inhalation Reference Dose (mg/kg-day)	Hazard Index Inhalation
Tetrachloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.43E-03	1.00E+00	8.43E-03	1.00E-02	8.43E-01
Trichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.20E-04	1.00E+00	1.20E-04	ND	ND
trans-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.01E-05	1.00E+00	4.01E-05	2.00E-02	2.00E-03
cis-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.11E-05	1.00E+00	4.11E-05	1.00E-02	4.11E-03
Vinyle Chloride	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.22E-05	1.00E+00	8.22E-05	ND	ND

POTENTIAL NONCARCINOGENIC HAZARD INDEX ASSOCIATED WITH INHALATION AND INGESTION OF CHEMICALS IN AIR

CHEMICAL	Hazard Index Inhalation	Hazard Index Ingestion	Total Hazard Index
Tetrachloroethene	8.43E-01	0.00E+00	8.43E-01
Trichloroethene	ND	0.00E+00	NA
trans-1,2-Dichloroethene	2.00E-03	0.00E+00	2.00E-03
cis-1,2-Dichloroethene	4.11E-03	0.00E+00	4.11E-03
Vinyle Chloride	ND	N.D.	N.D.
Total =	8.50E-01	0.00E+00	8.50E-01

CHRONIC12.WQ1 24-Mar-92 R.N.: 02

SOURCE: ENSR 1990

Appendix E

Risk Assessment Calculations Using the Upper 95TH Percent Confidence Value of the Arithmetic Mean of the Chemical Concentrations

Risk Assessment Calculations
Carcinogenic Assessment
Subchronic 24 Hour Exposure

Carcinogenic Assessment
Risk By Inhalation and Ingestion Of Chemicals In Air (95th Percentile Concentrations Subchronic Residential Exposure 24 hours/day)

CHEMICAL-RELATED VARIABLES Chemical	Chemical Concentration In Air (mg/m3 air)	Lung Retention Factor	Inhaled Particle Ingestion Factor	Inhalation Absorption Adjustment Factor	Oral Absorption Adjustment Factor	Inhalation Cancer Slope Factor ((mg/kg-day)^-1)	Oral Cancer Slope Factor ((mg/kg-day)^-1)
Tetrachloroethene	3.41E-02	1	0	1	1.00E+00	1.82E-03	5.10E-02
Trichloroethene	1.04E-03	1	0	0.35	1.00E+00	1.70E-02	1.10E-02
trans-1,2-Dichloroethene	1.90E-04	1	0	1	1.00E+00	ND	ND
cis-1,2-Dichloroethene	2.50E-04	1	0	1	1.00E+00	ND	ND

```
+--------------------------------------+
|Enter Receptor Names:                 |
|                                      |
|Receptor #1:                          |
|Receptor #2:                          |
|Receptor #3:           Adult          |
+--------------------------------------+


Assumptions for
Carcinogenic Assessment
Risk By Inhalation and Ingestion Of Chemicals In Air (95th Percentile Concentrations S  Assumed Value (units)
====================================================================                ===================================
Inhalation Rate                                                                            NA (m3 air/day)
Inhalation Rate                                                                            NA (m3 air/day)
Inhalation Rate                 Adult                                                      15 (m3 air/day)
Body Weight                                                                                70 (kg)
Body Weight                                                                                70 (kg)
Body Weight                     Adult                                                      70 (kg)
Exposure Time                                                                              NA (hrs)/24 (hrs) =    0.00E+00
Exposure Time                                                                              NA (hrs)/24 (hrs) =    0.00E+00
Exposure Time                   Adult                                                      24 (hrs)/24 (hrs) =    1.00E+00
Exposure Frequency                                                                         NA (days)/365 (days) = 0.00E+00
Exposure Frequency                                                                         NA (days)/365 (days) = 0.00E+00
Exposure Frequency              Adult                                                     350 (days)/365 (days) = 9.59E-01
Exposure Duration                                                                          NA (yrs)/ 30 (yrs) =   0.00E+00
Exposure Duration                                                                          NA (yrs)/ 30 (yrs) =   0.00E+00
Exposure Duration               Adult                                                       1 (yrs)/ 70 (yrs) =   1.43E-02
90th percentile residential                                                                70 (years)
```

Potential Carcinogenic Risk Associated With Potential Inhalation And Ingestion Of Chemicals In Air

The average daily dose (ADD) from inhalation of air is calculated for each receptor using the following equation:

```
      ADDinh =  Chemical        * Inhalation    * Lung         * Exposure      * Exposure      * Inhalation        / Body
 (mg/kg-day)  Concentration       Rate            Retention      Time Per        Frequency       Absorption          Weight
              In Air              (m3 air/day)    Factor         24 Hours        Per 365 Days    Adjustment          (kg)
              (mg/m3 air)                                        (hours/hours)   (day/day)       Factor
```

The average daily dose (ADD) from ingestion of entrained particles in air is calculated using the following equation:

```
      ADDing =  Chemical        * Inhalation    * Inhaled      * Exposure      * Exposure      * Oral              / Body
 (mg/kg-day)  Concentration       Rate            Particle       Time Per        Frequency       Absorption          Weight
              In Air              (m3 air/day)    Ingestion      24 Hours        Per 365 Days    Adjustment          (kg)
              (mg/m3 air)                         Factor         (hours/hours)   (day/day)       Factor
```

The lifetime average daily dose (LADD) is calculated for each pathway using the following equation, where:

```
Receptor #1 (R1) =
Receptor #2 (R2) =
Receptor #3 (R3) =      Adult



Averaging Time =        AT              Where: AT = Exposure Duration/Lifetime
                                                      (years)        (years)
         LADD =  (ADD,R1 * AT,R1)  +  (ADD,R2 * AT,R2)  +  (ADD,R3 * AT,R3)
    (mg/kg-day)  (mg/kg-day)           (mg/kg-day)          (mg/kg-day)
```

The excess lifetime cancer risk associated with inhalation is calculated using the following equation:

```
   Excess Lifetime =  LADDinhalation * Inhalation Cancer Slope Factor
       Cancer Risk    (mg/kg-day)      ((mg/kg-day)^1)
```

The excess lifetime cancer risk associated with ingestion of entrained particles is calculated using the following equation:

```
   Excess Lifetime =  LADDingestion  * Oral Cancer Slope Factor
       Cancer Risk    (mg/kg-day)      ((mg/kg-day)^1)
```

The total excess lifetime cancer risk is calculated using the following equation:

```
          Total Excess = Excess Lifetime Cancer Risk (inhalation) + Excess Lifetime Cancer Risk (ingestion)
Lifetime Cancer Risk
```

Inhalation - Chronic Exposures
Carcinogenic Assessment
Adult

CHEMICAL	Chemical Concentration In Air (mg/m3 air)	Inhalation Rate (m3 air/day)	Lung Retention Factor	Exposure Time Per 24 Hours (hours/hours)	Exposure Frequency Per 365 Days (day/day)	Inhalation Absorption Adjustment Factor	Body Weight (kg)	Average Daily Dose (mg/kg-day)
Tetrachloroethene	3.41E-02	15.0	1	1.00E+00	9.59E-01	1	70	7.00E-03
Trichloroethene	1.04E-03	15.0	1	1.00E+00	9.59E-01	0.35	70	7.48E-05
trans-1,2-Dichloroethene	1.90E-04	15.0	1	1.00E+00	9.59E-01	1	70	3.90E-05
cis-1,2-Dichloroethene	2.50E-04	15.0	1	1.00E+00	9.59E-01	1	70	5.14E-05

POTENTIAL CARCINOGENIC RISK ASSOCIATED WITH INHALATION OF AIR

Average Daily Dose From Potential Inhalation Of Air

CHEMICAL	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	Adult ADDinhalation (mg/kg-day)	Averaging Time Adult (years/years)	Lifetime ADDinhalation (mg/kg-day)	Inhalation Cancer Slope Factor ((mg/kg-day)^-1)	Excess Lifetime Cancer Risk Inhalation
Tetrachloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.00E-03	1.43E-02	1.00E-04	1.82E-03	1.82E-07
Trichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.48E-05	1.43E-02	1.07E-06	1.70E-02	1.82E-08
trans-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.90E-05	1.43E-02	5.58E-07	ND	ND
cis-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.14E-05	1.43E-02	7.34E-07	ND	ND

POTENTIAL CARCINOGENIC RISK ASSOCIATED WITH INHALATION AND INGESTION OF CHEMICALS IN AIR

CHEMICAL	Excess Lifetime Cancer Risk Inhalation	Excess Lifetime Cancer Risk Ingestion	Total Excess Lifetime Cancer Risk
Tetrachloroethene	1.82E-07	0.00E+00	1.82E-07
Trichloroethene	1.82E-08	0.00E+00	1.82E-08
trans-1,2-Dichloroethene	ND	ND	ND
cis-1,2-Dichloroethene	ND	ND	ND
Total =	2.00E-07	0.00E+00	2.00E-07

NESESC.WQ1 25-Mar-92 R.N.: 01

SOURCE: ENSR 1990

Risk Assessment Calculations
Carcinogenic Assessment
Chronic 8 Hour Residential Exposure

Carcinogenic Assessment
Risk By Inhalation and Ingestion Of Chemicals In Air (95th Percentile Concentrations Chronic Residential Exposure 8 hours/day)

CHEMICAL-RELATED VARIABLES Chemical	Chemical Concentration In Air (mg/m3 air)	Lung Retention Factor	Inhaled Particle Ingestion Factor	Inhalation Absorption Adjustment Factor	Oral Absorption Adjustment Factor	Inhalation Cancer Slope Factor ((mg/kg-day)^-1)	Oral Cancer Slope Factor ((mg/kg-day)^-1)
Tetrachloroethene	3.41E-02	1	0	1	1.00E+00	1.82E-03	5.10E-02
Trichloroethene	1.04E-03	1	0	0.35	1.00E+00	1.70E-02	1.10E-02
trans-1,2-Dichloroethene	1.90E-04	1	0	1	1.00E+00	ND	ND
cis-1,2-Dichloroethene	2.50E-04	1	0	1	1.00E+00	ND	ND

```
+-------------------------------------+
|Enter Receptor Names:                |
|                                     |
|Receptor #1:                         |
|Receptor #2:                         |
|Receptor #3:           Adult         |
+-------------------------------------+


Assumptions for
Carcinogenic Assessment
Risk By Inhalation and Ingestion Of Chemicals In Air (95th Percentile Concentrations C  Assumed Value (units)
====================================================================             ===================================
Inhalation Rate                                                                          NA (m3 air/day)
Inhalation Rate                                                                          NA (m3 air/day)
Inhalation Rate                Adult                                                     15 (m3 air/day)
Body Weight                                                                              70 (kg)
Body Weight                                                                              70 (kg)
Body Weight                    Adult                                                     70 (kg)
Exposure Time                                                                            NA (hrs)/24 (hrs) =    0.00E+00
Exposure Time                                                                            NA (hrs)/24 (hrs) =    0.00E+00
Exposure Time                  Adult                                                      8 (hrs)/24 (hrs) =    3.33E-01
Exposure Frequency                                                                       NA (days)/365 (days) = 0.00E+00
Exposure Frequency                                                                       NA (days)/365 (days) = 0.00E+00
Exposure Frequency             Adult                                                    350 (days)/365 (days) = 9.59E-01
Exposure Duration                                                                        NA (yrs)/ 30 (yrs) =   0.00E+00
Exposure Duration                                                                        NA (yrs)/ 30 (yrs) =   0.00E+00
Exposure Duration              Adult                                                     30 (yrs)/ 70 (yrs) =   4.29E-01
90th percentile residential                                                              70 (years)
```

Potential Carcinogenic Risk Associated With Potential Inhalation And Ingestion Of Chemicals In Air

The average daily dose (ADD) from inhalation of air is calculated for each receptor using the following equation:

```
      ADDinh =  Chemical       * Inhalation    * Lung         * Exposure      * Exposure      * Inhalation      / Body
  (mg/kg-day) Concentration     Rate            Retention      Time Per        Frequency       Absorption        Weight
              In Air            (m3 air/day)    Factor         24 Hours        Per 365 Days    Adjustment        (kg)
              (mg/m3 air)                                      (hours/hours)   (day/day)       Factor
```

The average daily dose (ADD) from ingestion of entrained particles in air is calculated using the following equation:

```
      ADDing =  Chemical       * Inhalation    * Inhaled      * Exposure      * Exposure      * Oral            / Body
  (mg/kg-day) Concentration     Rate            Particle       Time Per        Frequency       Absorption        Weight
              In Air            (m3 air/day)    Ingestion      24 Hours        Per 365 Days    Adjustment        (kg)
              (mg/m3 air)                       Factor         (hours/hours)   (day/day)       Factor
```

The lifetime average daily dose (LADD) is calculated for each pathway using the following equation, where:

```
Receptor #1 (R1) =
Receptor #2 (R2) =
Receptor #3 (R3) =      Adult



Averaging Time =        AT             Where: AT = Exposure Duration/Lifetime
                                                    (years)       (years)
            LADD =  (ADD,R1 * AT,R1)  +  (ADD,R2 * AT,R2)  +  (ADD,R3 * AT,R3)
       (mg/kg-day) (mg/kg-day)          (mg/kg-day)          (mg/kg-day)
```

The excess lifetime cancer risk associated with inhalation is calculated using the following equation:

```
    Excess Lifetime =  LADDinhalation * Inhalation Cancer Slope Factor
        Cancer Risk    (mg/kg-day)      ((mg/kg-day)^1)
```

The excess lifetime cancer risk associated with ingestion of entrained particles is calculated using the following equation:

```
    Excess Lifetime =  LADDingestion  * Oral Cancer Slope Factor
        Cancer Risk    (mg/kg-day)      ((mg/kg-day)^1)
```

The total excess lifetime cancer risk is calculated using the following equation:

```
        Total Excess = Excess Lifetime Cancer Risk (inhalation) + Excess Lifetime Cancer Risk (ingestion)
Lifetime Cancer Risk
```

Inhalation - Chronic Exposures
Carcinogenic Assessment
Adult

CHEMICAL	Chemical Concentration In Air (mg/m3 air)	Inhalation Rate (m3 air/day)	Lung Retention Factor	Exposure Time Per 24 Hours (hours/hours)	Exposure Frequency Per 365 Days (day/day)	Inhalation Absorption Adjustment Factor	Body Weight (kg)	Average Daily Dose (mg/kg-day)
Tetrachloroethene	3.41E-02	15.0	1	3.33E-01	9.59E-01	1	70	2.33E-03
Trichloroethene	1.04E-03	15.0	1	3.33E-01	9.59E-01	0.35	70	2.49E-05
trans-1,2-Dichloroethene	1.90E-04	15.0	1	3.33E-01	9.59E-01	1	70	1.30E-05
cis-1,2-Dichloroethene	2.50E-04	15.0	1	3.33E-01	9.59E-01	1	70	1.71E-05

POTENTIAL CARCINOGENIC RISK ASSOCIATED WITH INHALATION OF AIR

Average Daily Dose From Potential Inhalation Of Air

CHEMICAL	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	Adult ADDinhalation (mg/kg-day)	Averaging Time Adult (years/years)	Lifetime ADDinhalation (mg/kg-day)	Inhalation Cancer Slope Factor ((mg/kg-day)^-1)	Excess Lifetime Cancer Risk Inhalation
Tetrachloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.33E-03	4.29E-01	1.00E-03	1.82E-03	1.82E-06
Trichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.49E-05	4.29E-01	1.07E-05	1.70E-02	1.82E-07
trans-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.30E-05	4.29E-01	5.58E-06	ND	ND
cis-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.71E-05	4.29E-01	7.34E-06	ND	ND

POTENTIAL CARCINOGENIC RISK ASSOCIATED WITH INHALATION AND INGESTION OF CHEMICALS IN AIR

CHEMICAL	Excess Lifetime Cancer Risk Inhalation	Excess Lifetime Cancer Risk Ingestion	Total Excess Lifetime Cancer Risk
Tetrachloroethene	1.82E-06	0.00E+00	1.82E-06
Trichloroethene	1.82E-07	0.00E+00	1.82E-07
trans-1,2-Dichloroethene	ND	ND	ND
cis-1,2-Dichloroethene	ND	ND	ND
Total =	2.00E-06	0.00E+00	2.00E-06

NESEC8.WQ1 25-Mar-92 R.N.: 01

SOURCE: ENSR 1990

Risk Assessment Calculations
Carcinogenic Assessment
Chronic 12 Hour Residential Exposure

Carcinogenic Assessment
Risk By Inhalation and Ingestion Of Chemicals In Air (95th Percentile Concentrations Chronic Residential Exposure 12 hours/day)

CHEMICAL-RELATED VARIABLES Chemical	Chemical Concentration In Air (mg/m3 air)	Lung Retention Factor	Inhaled Particle Ingestion Factor	Inhalation Absorption Adjustment Factor	Oral Absorption Adjustment Factor	Inhalation Cancer Slope Factor ((mg/kg-day)^-1)	Oral Cancer Slope Factor ((mg/kg-day)^-1)
Tetrachloroethene	3.41E-02	1	0	1	1.00E+00	1.82E-03	5.10E-02
Trichloroethene	1.04E-03	1	0	0.35	1.00E+00	1.70E-02	1.10E-02
trans-1,2-Dichloroethene	1.90E-04	1	0	1	1.00E+00	ND	ND
cis-1,2-Dichloroethene	2.50E-04	1	0	1	1.00E+00	ND	ND

```
+-------------------------------------+
|Enter Receptor Names:                |
|                                     |
|Receptor #1:                         |
|Receptor #2:                         |
|Receptor #3:          Adult          |
+-------------------------------------+


Assumptions for
Carcinogenic Assessment
Risk By Inhalation and Ingestion Of Chemicals In Air (95th Percentile Concentrations C  Assumed Value (units)
====================================================================               ==================================
Inhalation Rate                                                                               NA (m3 air/day)
Inhalation Rate                                                                               NA (m3 air/day)
Inhalation Rate                Adult                                                          15 (m3 air/day)
Body Weight                                                                                   70 (kg)
Body Weight                                                                                   70 (kg)
Body Weight                    Adult                                                          70 (kg)
Exposure Time                                                                                 NA (hrs)/24 (hrs) =    0.00E+00
Exposure Time                                                                                 NA (hrs)/24 (hrs) =    0.00E+00
Exposure Time                  Adult                                                          12 (hrs)/24 (hrs) =    5.00E-01
Exposure Frequency                                                                            NA (days)/365 (days) = 0.00E+00
Exposure Frequency                                                                            NA (days)/365 (days) = 0.00E+00
Exposure Frequency             Adult                                                         350 (days)/365 (days) = 9.59E-01
Exposure Duration                                                                             NA (yrs)/ 30 (yrs) =   0.00E+00
Exposure Duration                                                                             NA (yrs)/ 30 (yrs) =   0.00E+00
Exposure Duration              Adult                                                          30 (yrs)/ 70 (yrs) =   4.29E-01
90th percentile residential                                                                   70 (years)
```

Potential Carcinogenic Risk Associated With Potential Inhalation And Ingestion Of Chemicals In Air

```
The average daily dose (ADD) from inhalation of air is calculated for each receptor using the following equation:
              ADDinh =  Chemical       * Inhalation    * Lung          * Exposure      * Exposure      * Inhalation       / Body
            (mg/kg-day) Concentration    Rate            Retention       Time Per        Frequency       Absorption         Weight
                        In Air           (m3 air/day)    Factor          24 Hours        Per 365 Days    Adjustment         (kg)
                        (mg/m3 air)                                      (hours/hours)   (day/day)       Factor

The average daily dose (ADD) from ingestion of entrained particles in air is calculated using the following equation:
              ADDing =  Chemical       * Inhalation    * Inhaled       * Exposure      * Exposure      * Oral             / Body
            (mg/kg-day) Concentration    Rate            Particle        Time Per        Frequency       Absorption         Weight
                        In Air           (m3 air/day)    Ingestion       24 Hours        Per 365 Days    Adjustment         (kg)
                        (mg/m3 air)                      Factor          (hours/hours)   (day/day)       Factor

The lifetime average daily dose (LADD) is calculated for each pathway using the following equation, where:

Receptor #1 (R1) =
Receptor #2 (R2) =
Receptor #3 (R3) =      Adult



Averaging Time =        AT             Where: AT = Exposure Duration/Lifetime
                                                        (years)        (years)
                LADD =  (ADD,R1 * AT,R1)   +  (ADD,R2 * AT,R2)  +  (ADD,R3 * AT,R3)
            (mg/kg-day) (mg/kg-day)           (mg/kg-day)          (mg/kg-day)

The excess lifetime cancer risk associated with inhalation is calculated using the following equation:
     Excess Lifetime =  LADDinhalation * Inhalation Cancer Slope Factor
         Cancer Risk    (mg/kg-day)      ((mg/kg-day)^1)

The excess lifetime cancer risk associated with ingestion of entrained particles is calculated using the following equation:
     Excess Lifetime =  LADDingestion  * Oral Cancer Slope Factor
         Cancer Risk    (mg/kg-day)      ((mg/kg-day)^1)

The total excess lifetime cancer risk is calculated using the following equation:
         Total Excess = Excess Lifetime Cancer Risk (inhalation) + Excess Lifetime Cancer Risk (ingestion)
Lifetime Cancer Risk


==============================================================================================================================================================
```

Inhalation - Chronic Exposures
Carcinogenic Assessment
Adult

CHEMICAL	Chemical Concentration In Air (mg/m3 air)	Inhalation Rate (m3 air/day)	Lung Retention Factor	Exposure Time Per 24 Hours (hours/hours)	Exposure Frequency Per 365 Days (day/day)	Inhalation Absorption Adjustment Factor	Body Weight (kg)	Average Daily Dose (mg/kg-day)
Tetrachloroethene	3.41E-02	15.0	1	5.00E-01	9.59E-01	1	70	3.50E-03
Trichloroethene	1.04E-03	15.0	1	5.00E-01	9.59E-01	0.35	70	3.74E-05
trans-1,2-Dichloroethene	1.90E-04	15.0	1	5.00E-01	9.59E-01	1	70	1.95E-05
cis-1,2-Dichloroethene	2.50E-04	15.0	1	5.00E-01	9.59E-01	1	70	2.57E-05

POTENTIAL CARCINOGENIC RISK ASSOCIATED WITH INHALATION OF AIR

Average Daily Dose From Potential Inhalation Of Air

CHEMICAL	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	Adult ADDinhalation (mg/kg-day)	Averaging Time Adult (years/years)	Lifetime ADDinhalation (mg/kg-day)	Inhalation Cancer Slope Factor ((mg/kg-day)^-1)	Excess Lifetime Cancer Risk Inhalation
Tetrachloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.50E-03	4.29E-01	1.50E-03	1.82E-03	2.73E-06
Trichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.74E-05	4.29E-01	1.60E-05	1.70E-02	2.72E-07
trans-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.95E-05	4.29E-01	8.37E-06	ND	ND
cis-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.57E-05	4.29E-01	1.10E-05	ND	ND

POTENTIAL CARCINOGENIC RISK ASSOCIATED WITH INHALATION AND INGESTION OF CHEMICALS IN AIR

CHEMICAL	Excess Lifetime Cancer Risk Inhalation	Excess Lifetime Cancer Risk Ingestion	Total Excess Lifetime Cancer Risk
Tetrachloroethene	2.73E-06	0.00E+00	2.73E-06
Trichloroethene	2.72E-07	0.00E+00	2.72E-07
trans-1,2-Dichloroethene	ND	ND	ND
cis-1,2-Dichloroethene	ND	ND	ND
Total =	3.00E-06	0.00E+00	3.00E-06

NESEC12.WQ1 25-Mar-92 R.N.: 01

SOURCE: ENSR 1990

Risk Assessment Calculations
Noncarcinogenic Assessment
Subchronic 24 Hour Exposure

Noncarcinogenic Assessment

Exposure By Inhalation and Ingestion Of Chemicals In Air (95th Percentile Concentrations Subchronic 24 hours/day)

CHEMICAL-RELATED VARIABLES Chemical	Chemical Concentration In Air (mg/m3 air)	Lung Retention Factor	Inhaled Particle Ingestion Factor	Inhalation Absorption Adjustment Factor	Oral Absorption Adjustment Factor	Inhalation Reference Dose (mg/kg-day)	Oral Reference Dose (mg/kg-day)
Tetrachloroethene	3.41E-02	1	0	1	1.00E+00	1.00E-01	1.00E-01
Trichloroethene	1.04E-03	1	0	0.35	1.00E+00	ND	ND
trans-1,2-Dichloroethene	1.90E-04	1	0	1	1.00E+00	2.00E-01	2.00E-01
cis-1,2-Dichloroethene	2.50E-04	1	0	1	1.00E+00	1.00E-01	1.00E-01

```
+----------------------------------------+
|Enter Receptor Names:                   |
|                                        |
|Receptor #1:                            |
|Receptor #2:                            |
|Receptor #3:           Adult            |
+----------------------------------------+


Assumptions for
Noncarcinogenic Assessment
Exposure By Inhalation and Ingestion Of Chemicals In Air (95th Percentile Concentrations SAssumed Value   (units)
=========================================================================                 =================================
Inhalation Rate                                                                                        NA (m3 air/day)
Inhalation Rate                                                                                        NA (m3 air/day)
Inhalation Rate                   Adult                                                                15 (m3 air/day)
Body Weight                                                                                            70 (kg)
Body Weight                                                                                            70 (kg)
Body Weight                       Adult                                                                70 (kg)
Exposure Time                                                                                          NA (hrs)/24 hrs) =  0.00E+00
Exposure Time                                                                                          NA (hrs)/24 hrs) =  0.00E+00
Exposure Time                     Adult                                                                24 (hrs)/24 hrs) =  1.00E+00
Exposure Frequency                                                                                     NA (days)/365 days =0.00E+00
Exposure Frequency                                                                                     NA (days)/365 days =0.00E+00
Exposure Frequency                Adult                                                               350 (days)/365 days =9.59E-01
Exposure Duration                                                                                      NA (yrs)/69 (yrs) = 0.00E+00
Exposure Duration                                                                                      NA (yrs)/69 (yrs) = 0.00E+00
Exposure Duration                 Adult                                                                 1 (yrs)/69 (yrs) = 1.00E+00
Total Exposure Duration                                                                                 1 (years)




======================================================================================================================================================================
```

Potential Noncarcinogenic Hazard Index Associated With Potential Inhalation And Ingestion Of Chemicals In Air

The average daily dose (ADD) from inhalation of air is calculated for each receptor using the following equation:

```
      ADDinh = Chemical        * Inhalation   * Lung         * Exposure       * Exposure      * Inhalation    / Body
  (mg/kg-day) Concentration      Rate           Retention      Time Per         Frequency       Absorption      Weight
               In Air            (m3 air/day)   Factor         24 Hours         Per 365 Days    Adjustment      (kg)
               (mg/m3 air)                                     (hours/hours)    (day/day)       Factor
```

The average daily dose (ADD) from ingestion of entrained particles in air is calculated using the following equation:

```
      ADDing = Chemical        * Inhalation   * Inhaled      * Exposure       * Exposure      * Oral          / Body
  (mg/kg-day) Concentration      Rate           Particle       Time Per         Frequency       Absorption      Weight
               In Air            (m3 air/day)   Ingestion      24 Hours         Per 365 Days    Adjustment      (kg)
               (mg/m3 air)                      Factor         (hours/hours)    (day/day)       Factor
```

The chronic average daily dose (CADD) is calculated for each pathway using the following equation, where:

```
Receptor #1 (R1) =
Receptor #2 (R2) =
Receptor #3 (R3) =     Adult



Averaging Time =       AT             Where: AT = Exposure Duration/Total Exposure Duration
                                                    (year)          (year)
           CADD =  (ADD,R1 * AT,R1)  +  (ADD,R2 * AT,R2)  +  (ADD,R3 * AT,R3)
      (mg/kg-day) (mg/kg-day)          (mg/kg-day)          (mg/kg-day)
```

The hazard index associated with inhalation is calculated using the following equation:

```
      Hazard Index =  CADDInhalation  / Inhalation RfD
        inhalation    (mg/kg-day)       (mg/kg-day)
```

The hazard index associated with ingestion of entrained particles is calculated using the following equation:

```
      Hazard Index =  CADDIngestion   / Oral RfD
         ingestion    (mg/kg-day)       (mg/kg-day)
```

The total hazard index is calculated using the following equation:

```
             Total =  Hazard Index    + Hazard Index
      Hazard Index    Inhalation        Ingestion
```

Inhalation - Chronic Exposures
Noncarcinogenic Assessment
Adult

CHEMICAL	Chemical Concentration In Air (mg/m3 air)	Inhalation Rate (m3 air/day)	Lung Retention Factor	Exposure Time Per 24 Hours (hours/hours)	Exposure Frequency Per 365 Days (day/day)	Inhalation Absorption Adjustment Factor	Body Weight (kg)	Average Daily Dose (mg/kg-day)
Tetrachloroethene	3.41E-02	15.0	1	1.00E+00	9.59E-01	1	70	7.00E-03
Trichloroethene	1.04E-03	15.0	1	1.00E+00	9.59E-01	0.35	70	7.48E-05
trans-1,2-Dichloroethene	1.90E-04	15.0	1	1.00E+00	9.59E-01	1	70	3.90E-05
cis-1,2-Dichloroethene	2.50E-04	15.0	1	1.00E+00	9.59E-01	1	70	5.14E-05

POTENTIAL NONCARCINOGENIC HAZARD INDEX ASSOCIATED WITH INHALATION OF AIR

Average Daily Dose From Potential Inhalation Of Air

CHEMICAL	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	Adult ADDinhalation (mg/kg-day)	Averaging Time Adult (years/years)	Chronic ADDinhalation (mg/kg-day)	Inhalation Reference Dose (mg/kg-day)	Hazard Index Inhalation
Tetrachloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.00E-03	1.00E+00	7.00E-03	1.00E-01	7.00E-02
Trichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.48E-05	1.00E+00	7.48E-05	ND	ND
trans-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.90E-05	1.00E+00	3.90E-05	2.00E-01	1.95E-04
cis-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.14E-05	1.00E+00	5.14E-05	1.00E-01	5.14E-04

POTENTIAL NONCARCINOGENIC HAZARD INDEX ASSOCIATED WITH INHALATION AND INGESTION OF CHEMICALS IN AIR

CHEMICAL	Hazard Index Inhalation	Hazard Index Ingestion	Total Hazard Index
Tetrachloroethene	7.00E-02	0.00E+00	7.00E-02
Trichloroethene	ND	ND	ND
trans-1,2-Dichloroethene	1.95E-04	0.00E+00	1.95E-04
cis-1,2-Dichloroethene	5.14E-04	0.00E+00	5.14E-04
Total =	7.07E-02	0.00E+00	7.07E-02

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SOURCE: ENSR 1990

Risk Assessment Calculations
Noncarcinogenic Assessment
Chronic 8 Hour Residential Exposure

Noncarcinogenic Assessment

Exposure By Inhalation and Ingestion Of Chemicals In Air (95th Percentile Chronic Residential Exposure 8 hours/day)

CHEMICAL-RELATED VARIABLES Chemical	Chemical Concentration In Air (mg/m3 air)	Lung Retention Factor	Inhaled Particle Ingestion Factor	Inhalation Absorption Adjustment Factor	Oral Absorption Adjustment Factor	Inhalation Reference Dose (mg/kg-day)	Oral Reference Dose (mg/kg-day)
Tetrachloroethene	3.41E-02	1	0	1	1	1.00E-02	1.00E-02
Trichloroethene	1.04E-03	1	0	0.35	1	ND	ND
trans-1,2-Dichloroethene	1.90E-04	1	0	1	1	2.00E-02	2.00E-02
cis-1,2-Dichloroethene	2.50E-04	1	0	1	1	1.00E-02	1.00E-02

```
+--------------------------------------+
|Enter Receptor Names:                 |
|                                      |
|Receptor #1:                          |
|Receptor #2:                          |
|Receptor #3:          Adult           |
+--------------------------------------+


Assumptions for
Noncarcinogenic Assessment
Exposure By Inhalation and Ingestion Of Chemicals In Air (95th Percentile Chronic ResidentAssumed Value   (units)
=========================================================================             =================================
Inhalation Rate                                                                              NA (m3 air/day)
Inhalation Rate                                                                              NA (m3 air/day)
Inhalation Rate                   Adult                                                      15 (m3 air/day)
Body Weight                                                                                  70 (kg)
Body Weight                                                                                  70 (kg)
Body Weight                       Adult                                                      70 (kg)
Exposure Time                                                                                NA (hrs)/24 hrs) =  0.00E+00
Exposure Time                                                                                NA (hrs)/24 hrs) =  0.00E+00
Exposure Time                     Adult                                                       8 (hrs)/24 hrs) =  3.33E-01
Exposure Frequency                                                                           NA (days)/365 days =0.00E+00
Exposure Frequency                                                                           NA (days)/365 days =0.00E+00
Exposure Frequency                Adult                                                     350 (days)/365 days =9.59E-01
Exposure Duration                                                                            NA (yrs)/69 (yrs) = 0.00E+00
Exposure Duration                                                                            NA (yrs)/69 (yrs) = 0.00E+00
Exposure Duration                 Adult                                                      30 (yrs)/69 (yrs) = 1.00E+00
Total Exposure Duration                                                                      30 (years)
```

Potential Noncarcinogenic Hazard Index Associated With Potential Inhalation And Ingestion Of Chemicals In Air

The average daily dose (ADD) from inhalation of air is calculated for each receptor using the following equation:

```
        ADDinh =  Chemical        * Inhalation    * Lung          * Exposure        * Exposure      * Inhalation     / Body
   (mg/kg-day)  Concentration     Rate            Retention       Time Per          Frequency       Absorption       Weight
                In Air            (m3 air/day)    Factor          24 Hours          Per 365 Days    Adjustment       (kg)
                (mg/m3 air)                                       (hours/hours)     (day/day)       Factor
```

The average daily dose (ADD) from ingestion of entrained particles in air is calculated using the following equation:

```
        ADDing =  Chemical        * Inhalation    * Inhaled       * Exposure        * Exposure      * Oral           / Body
   (mg/kg-day)  Concentration     Rate            Particle        Time Per          Frequency       Absorption       Weight
                In Air            (m3 air/day)    Ingestion       24 Hours          Per 365 Days    Adjustment       (kg)
                (mg/m3 air)                       Factor          (hours/hours)     (day/day)       Factor
```

The chronic average daily dose (CADD) is calculated for each pathway using the following equation, where:

```
Receptor #1 (R1) =
Receptor #2 (R2) =
Receptor #3 (R3) =      Adult



Averaging Time =        AT              Where: AT = Exposure Duration/Total Exposure Duration
                                                     (year)         (year)
            CADD =  (ADD,R1 * AT,R1)  +  (ADD,R2 * AT,R2)  +  (ADD,R3 * AT,R3)
       (mg/kg-day) (mg/kg-day)           (mg/kg-day)           (mg/kg-day)
```

The hazard index associated with inhalation is calculated using the following equation:

```
      Hazard Index =  CADDInhalation  / Inhalation RfD
        inhalation    (mg/kg-day)       (mg/kg-day)
```

The hazard index associated with ingestion of entrained particles is calculated using the following equation:

```
      Hazard Index =  CADDIngestion   / Oral RfD
         ingestion    (mg/kg-day)       (mg/kg-day)
```

The total hazard index is calculated using the following equation:

```
             Total =  Hazard Index    + Hazard Index
      Hazard Index    Inhalation        Ingestion
```

Inhalation - Chronic Exposures
Noncarcinogenic Assessment
Adult

CHEMICAL	Chemical Concentration In Air (mg/m3 air)	Inhalation Rate (m3 air/day)	Lung Retention Factor	Exposure Time Per 24 Hours (hours/hours)	Exposure Frequency Per 365 Days (day/day)	Inhalation Absorption Adjustment Factor	Body Weight (kg)	Average Daily Dose (mg/kg-day)
Tetrachloroethene	3.41E-02	15.0	1	3.33E-01	9.59E-01	1	70	2.33E-03
Trichloroethene	1.04E-03	15.0	1	3.33E-01	9.59E-01	0.35	70	2.49E-05
trans-1,2-Dichloroethene	1.90E-04	15.0	1	3.33E-01	9.59E-01	1	70	1.30E-05
cis-1,2-Dichloroethene	2.50E-04	15.0	1	3.33E-01	9.59E-01	1	70	1.71E-05

POTENTIAL NONCARCINOGENIC HAZARD INDEX ASSOCIATED WITH INHALATION OF AIR

Average Daily Dose From Potential Inhalation Of Air

CHEMICAL	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	Adult ADDinhalation (mg/kg-day)	Averaging Time Adult (years/years)	Chronic ADDinhalation (mg/kg-day)	Inhalation Reference Dose (mg/kg-day)	Hazard Index Inhalation
Tetrachloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.33E-03	1.00E+00	2.33E-03	1.00E-02	2.33E-01
Trichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.49E-05	1.00E+00	2.49E-05	ND	ND
trans-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.30E-05	1.00E+00	1.30E-05	2.00E-02	6.51E-04
cis-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.71E-05	1.00E+00	1.71E-05	1.00E-02	1.71E-03

POTENTIAL NONCARCINOGENIC HAZARD INDEX ASSOCIATED WITH INHALATION AND INGESTION OF CHEMICALS IN AIR

CHEMICAL	Hazard Index Inhalation	Hazard Index Ingestion	Total Hazard Index
Tetrachloroethene	2.33E-01	0.00E+00	2.33E-01
Trichloroethene	ND	0.00E+00	NA
trans-1,2-Dichloroethene	6.51E-04	0.00E+00	6.51E-04
cis-1,2-Dichloroethene	1.71E-03	0.00E+00	1.71E-03
Total =	2.36E-01	0.00E+00	2.36E-01

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SOURCE: ENSR 1990

Risk Assessment Calculations
Noncarcinogenic Assessment
Chronic 12 Hour Residential Exposure

Noncarcinogenic Assessment

Exposure By Inhalation and Ingestion Of Chemicals In Air (95th Percentile Chronic Residential Exposure 12 hours/day)

CHEMICAL-RELATED VARIABLES Chemical	Chemical Concentration In Air (mg/m3 air)	Lung Retention Factor	Inhaled Particle Ingestion Factor	Inhalation Absorption Adjustment Factor	Oral Absorption Adjustment Factor	Inhalation Reference Dose (mg/kg-day)	Oral Reference Dose (mg/kg-day)
Tetrachloroethene	3.41E-02	1	0	1	1	1.00E-02	1.00E-02
Trichloroethene	1.04E-03	1	0	0.35	1	ND	ND
trans-1,2-Dichloroethene	1.90E-04	1	0	1	1	2.00E-02	2.00E-02
cis-1,2-Dichloroethene	2.50E-04	1	0	1	1	1.00E-02	1.00E-02

```
+--------------------------------------+
|Enter Receptor Names:                 |
|                                      |
|Receptor #1:                          |
|Receptor #2:                          |
|Receptor #3:          Adult           |
+--------------------------------------+


Assumptions for
Noncarcinogenic Assessment
Exposure By Inhalation and Ingestion Of Chemicals In Air (95th Percentile Chronic ResidentAssumed Value   (units)
=================================================================            ==============================
Inhalation Rate                                                                     NA (m3 air/day)
Inhalation Rate                                                                     NA (m3 air/day)
Inhalation Rate                Adult                                                15 (m3 air/day)
Body Weight                                                                         70 (kg)
Body Weight                                                                         70 (kg)
Body Weight                    Adult                                                70 (kg)
Exposure Time                                                                       NA (hrs)/24 hrs) =  0.00E+00
Exposure Time                                                                       NA (hrs)/24 hrs) =  0.00E+00
Exposure Time                  Adult                                                12 (hrs)/24 hrs) =  5.00E-01
Exposure Frequency                                                                  NA (days)/365 days =0.00E+00
Exposure Frequency                                                                  NA (days)/365 days =0.00E+00
Exposure Frequency             Adult                                               350 (days)/365 days =9.59E-01
Exposure Duration                                                                   NA (yrs)/69 (yrs) = 0.00E+00
Exposure Duration                                                                   NA (yrs)/69 (yrs) = 0.00E+00
Exposure Duration              Adult                                                30 (yrs)/69 (yrs) = 1.00E+00
Total Exposure Duration                                                             30 (years)
```

Potential Noncarcinogenic Hazard Index Associated With Potential Inhalation And Ingestion Of Chemicals In Air

```
The average daily dose (ADD) from inhalation of air is calculated for each receptor using the following equation:
           ADDinh =  Chemical         * Inhalation    * Lung          * Exposure        * Exposure       * Inhalation     / Body
         (mg/kg-day) Concentration      Rate            Retention       Time Per          Frequency        Absorption       Weight
                     In Air             (m3 air/day)    Factor          24 Hours          Per 365 Days     Adjustment       (kg)
                     (mg/m3 air)                                        (hours/hours)     (day/day)        Factor

The average daily dose (ADD) from ingestion of entrained particles in air is calculated using the following equation:
           ADDing =  Chemical         * Inhalation    * Inhaled       * Exposure        * Exposure       * Oral           / Body
         (mg/kg-day) Concentration      Rate            Particle        Time Per          Frequency        Absorption       Weight
                     In Air             (m3 air/day)    Ingestion       24 Hours          Per 365 Days     Adjustment       (kg)
                     (mg/m3 air)                        Factor          (hours/hours)     (day/day)        Factor

The chronic average daily dose (CADD) is calculated for each pathway using the following equation, where:

Receptor #1 (R1) =
Receptor #2 (R2) =
Receptor #3 (R3) =     Adult



Averaging Time =       AT              Where: AT = Exposure Duration/Total Exposure Duration
                                                   (year)         (year)
            CADD =   (ADD,R1 * AT,R1)  +  (ADD,R2 * AT,R2)  +  (ADD,R3 * AT,R3)
         (mg/kg-day) (mg/kg-day)            (mg/kg-day)            (mg/kg-day)

The hazard index associated with inhalation is calculated using the following equation:
        Hazard Index =  CADDInhalation  / Inhalation RfD
          inhalation    (mg/kg-day)       (mg/kg-day)

The hazard index associated with ingestion of entrained particles is calculated using the following equation:
        Hazard Index =  CADDIngestion   / Oral RfD
           ingestion    (mg/kg-day)       (mg/kg-day)

The total hazard index is calculated using the following equation:
               Total =  Hazard Index    + Hazard Index
        Hazard Index    Inhalation        Ingestion
```

Inhalation - Chronic Exposures
Noncarcinogenic Assessment
Adult

CHEMICAL	Chemical Concentration In Air (mg/m3 air)	Inhalation Rate (m3 air/day)	Lung Retention Factor	Exposure Time Per 24 Hours (hours/hours)	Exposure Frequency Per 365 Days (day/day)	Inhalation Absorption Adjustment Factor	Body Weight (kg)	Average Daily Dose (mg/kg-day)
Tetrachloroethene	3.41E-02	15.0	1	5.00E-01	9.59E-01	1	70	3.50E-03
Trichloroethene	1.04E-03	15.0	1	5.00E-01	9.59E-01	0.35	70	3.74E-05
trans-1,2-Dichloroethene	1.90E-04	15.0	1	5.00E-01	9.59E-01	1	70	1.95E-05
cis-1,2-Dichloroethene	2.50E-04	15.0	1	5.00E-01	9.59E-01	1	70	2.57E-05

POTENTIAL NONCARCINOGENIC HAZARD INDEX ASSOCIATED WITH INHALATION OF AIR

Average Daily Dose From Potential Inhalation Of Air

CHEMICAL	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	Adult ADDinhalation (mg/kg-day)	Averaging Time Adult (years/years)	Chronic ADDinhalation (mg/kg-day)	Inhalation Reference Dose (mg/kg-day)	Hazard Index Inhalation
Tetrachloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.50E-03	1.00E+00	3.50E-03	1.00E-02	3.50E-01
Trichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.74E-05	1.00E+00	3.74E-05	ND	ND
trans-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.95E-05	1.00E+00	1.95E-05	2.00E-02	9.76E-04
cis-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.57E-05	1.00E+00	2.57E-05	1.00E-02	2.57E-03

POTENTIAL NONCARCINOGENIC HAZARD INDEX ASSOCIATED WITH INHALATION AND INGESTION OF CHEMICALS IN AIR

CHEMICAL	Hazard Index Inhalation	Hazard Index Ingestion	Total Hazard Index
Tetrachloroethene	3.50E-01	0.00E+00	3.50E-01
Trichloroethene	ND	0.00E+00	NA
trans-1,2-Dichloroethene	9.76E-04	0.00E+00	9.76E-04
cis-1,2-Dichloroethene	2.57E-03	0.00E+00	2.57E-03
Total =	3.54E-01	0.00E+00	3.54E-01

NESENCC12.WQ1 25-Mar-92 R.N.: 01

SOURCE: ENSR 1990

Appendix F
Risk Assessment Calculations Using the Chemical Concentrations from Residence NE-1

Risk Assessment Calculations
Carcinogenic Assessment
Chronic Site-Specific Time in Basement

Carcinogenic Assessment

Risk By Inhalation and Ingestion Of Chemicals In Air (NE-1 Basement Site-specic Chronic Residential Exposure)

CHEMICAL-RELATED VARIABLES Chemical	Chemical Concentration In Air (mg/m3 air)	Lung Retention Factor	Inhaled Particle Ingestion Factor	Inhalation Absorption Adjustment Factor	Oral Absorption Adjustment Factor	Inhalation Cancer Slope Factor ((mg/kg-day)^-1)	Oral Cancer Slope Factor ((mg/kg-day)^-1)
Tetrachloroethene	8.21E-02	1	0	1	1	1.82E-03	5.10E-02
Trichloroethene	1.50E-03	1	0	0.35	1	1.70E-02	1.10E-02
trans-1,2-Dichloroethene	1.60E-04	1	0	1	1	ND	ND
cis-1,2-Dichloroethene	2.60E-04	1	0	1	1	ND	ND
Vinyle Chloride	2.00E-05	1	0	1	1	2.94E-01	1.90E+00

```
+--------------------------------------+
|Enter Receptor Names:                 |
|                                      |
|Receptor #1:                          |
|Receptor #2:                          |
|Receptor #3:            Adult         |
+--------------------------------------+


Assumptions for
Carcinogenic Assessment
Risk By Inhalation and Ingestion Of Chemicals In Air (NE-1 Basement Site-specic Chroni  Assumed Value (units)
======================================================================          ====================================
Inhalation Rate                                                                      NA (m3 air/day)
Inhalation Rate                                                                      NA (m3 air/day)
Inhalation Rate                 Adult                                                15 (m3 air/day)
Body Weight                                                                          70 (kg)
Body Weight                                                                          70 (kg)
Body Weight                     Adult                                                70 (kg)
Exposure Time                                                                        NA (hrs)/24 (hrs) =    0.00E+00
Exposure Time                                                                        NA (hrs)/24 (hrs) =    0.00E+00
Exposure Time                   Adult                                              0.71 (hrs)/24 (hrs) =    2.96E-02
Exposure Frequency                                                                   NA (days)/365 (days) = 0.00E+00
Exposure Frequency                                                                   NA (days)/365 (days) = 0.00E+00
Exposure Frequency              Adult                                               350 (days)/365 (days) = 9.59E-01
Exposure Duration                                                                    NA (yrs)/ 30 (yrs) =   0.00E+00
Exposure Duration                                                                    NA (yrs)/ 30 (yrs) =   0.00E+00
Exposure Duration               Adult                                                30 (yrs)/ 70 (yrs) =   4.29E-01
90th percentile residential                                                          70 (years)
```

```
                   Potential Carcinogenic Risk Associated With Potential Inhalation And Ingestion Of Chemicals In Air


The average daily dose (ADD) from inhalation of air is calculated for each receptor using the following equation:
          ADDinh =  Chemical       * Inhalation    * Lung        * Exposure     * Exposure      * Inhalation        / Body
        (mg/kg-day) Concentration    Rate            Retention     Time Per       Frequency       Absorption          Weight
                    In Air           (m3 air/day)    Factor        24 Hours       Per 365 Days    Adjustment          (kg)
                    (mg/m3 air)                                    (hours/hours)  (day/day)       Factor

The average daily dose (ADD) from ingestion of entrained particles in air is calculated using the following equation:
          ADDing =  Chemical       * Inhalation    * Inhaled     * Exposure     * Exposure      * Oral              / Body
        (mg/kg-day) Concentration    Rate            Particle      Time Per       Frequency       Absorption          Weight
                    In Air           (m3 air/day)    Ingestion     24 Hours       Per 365 Days    Adjustment          (kg)
                    (mg/m3 air)                      Factor        (hours/hours)  (day/day)       Factor

The lifetime average daily dose (LADD) is calculated for each pathway using the following equation, where:

Receptor #1 (R1) =
Receptor #2 (R2) =
Receptor #3 (R3) =  Adult



Averaging Time =    AT          Where: AT = Exposure Duration/Lifetime
                                                (years)       (years)
             LADD = (ADD,R1 * AT,R1)  +  (ADD,R2 * AT,R2)  +  (ADD,R3 * AT,R3)
        (mg/kg-day) (mg/kg-day)           (mg/kg-day)          (mg/kg-day)

The excess lifetime cancer risk associated with inhalation is calculated using the following equation:
     Excess Lifetime =  LADDinhalation * Inhalation Cancer Slope Factor
         Cancer Risk    (mg/kg-day)      ((mg/kg-day)^1)

The excess lifetime cancer risk associated with ingestion of entrained particles is calculated using the following equation:
     Excess Lifetime =  LADDingestion  * Oral Cancer Slope Factor
         Cancer Risk    (mg/kg-day)      ((mg/kg-day)^1)

The total excess lifetime cancer risk is calculated using the following equation:
         Total Excess = Excess Lifetime Cancer Risk (inhalation) + Excess Lifetime Cancer Risk (ingestion)
Lifetime Cancer Risk


=========================================================================================================================
```

Inhalation - Chronic Exposures
Carcinogenic Assessment
Adult

CHEMICAL	Chemical Concentration In Air (mg/m3 air)	Inhalation Rate (m3 air/day)	Lung Retention Factor	Exposure Time Per 24 Hours (hours/hours)	Exposure Frequency Per 365 Days (day/day)	Inhalation Absorption Adjustment Factor	Body Weight (kg)	Average Daily Dose (mg/kg-day)
Tetrachloroethene	8.21E-02	15.0	1	2.96E-02	9.59E-01	1	70	4.99E-04
Trichloroethene	1.50E-03	15.0	1	2.96E-02	9.59E-01	0.35	70	3.19E-06
trans-1,2-Dichloroethene	1.60E-04	15.0	1	2.96E-02	9.59E-01	1	70	9.73E-07
cis-1,2-Dichloroethene	2.60E-04	15.0	1	2.96E-02	9.59E-01	1	70	1.58E-06
Vinyle Chloride	2.00E-05	15.0	1	2.96E-02	9.59E-01	1	70	1.22E-07

POTENTIAL CARCINOGENIC RISK ASSOCIATED WITH INHALATION OF AIR

Average Daily Dose From Potential Inhalation Of Air

CHEMICAL	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	Adult ADDinhalation (mg/kg-day)	Averaging Time Adult (years/years)	Lifetime ADDinhalation (mg/kg-day)	Inhalation Cancer Slope Factor ((mg/kg-day)^-1)	Excess Lifetime Cancer Risk Inhalation
Tetrachloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.99E-04	4.29E-01	2.14E-04	1.82E-03	3.89E-07
Trichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.19E-06	4.29E-01	1.37E-06	1.70E-02	2.33E-08
trans-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.73E-07	4.29E-01	4.17E-07	ND	ND
cis-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.58E-06	4.29E-01	6.77E-07	ND	ND
Vinyle Chloride	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.22E-07	4.29E-01	5.21E-08	2.94E-01	1.53E-08

POTENTIAL CARCINOGENIC RISK ASSOCIATED WITH INHALATION AND INGESTION OF CHEMICALS IN AIR

CHEMICAL	Excess Lifetime Cancer Risk Inhalation	Excess Lifetime Cancer Risk Ingestion	Total Excess Lifetime Cancer Risk
Tetrachloroethene	3.89E-07	0.00E+00	3.89E-07
Trichloroethene	2.33E-08	0.00E+00	2.33E-08
trans-1,2-Dichloroethene	ND	ND	ND
cis-1,2-Dichloroethene	ND	ND	ND
Vinyle Chloride	1.53E-08	0.00E+00	1.53E-08
Total =	4.28E-07	0.00E+00	4.28E-07

NE-1C.WQ1 25-Mar-92 R.N.: 01

SOURCE: ENSR 1990

Risk Assessment Calculations
Carcinogenic Assessment
Subchronic Site-Specific Time in Basement

Carcinogenic Assessment
Risk By Inhalation and Ingestion Of Chemicals In Air (NE-1 Basement Site-specic Subchronic Residential Exposure)

CHEMICAL-RELATED VARIABLES Chemical	Chemical Concentration In Air (mg/m3 air)	Lung Retention Factor	Inhaled Particle Ingestion Factor	Inhalation Absorption Adjustment Factor	Oral Absorption Adjustment Factor	Inhalation Cancer Slope Factor ((mg/kg-day)^-1)	Oral Cancer Slope Factor ((mg/kg-day)^-1)
Tetrachloroethene	8.21E-02	1	0	1	1	1.82E-03	5.10E-02
Trichloroethene	1.50E-03	1	0	0.35	1	1.70E-02	1.10E-02
trans-1,2-Dichloroethene	1.60E-04	1	0	1	1	ND	ND
cis-1,2-Dichloroethene	2.60E-04	1	0	1	1	ND	ND
Vinyle Chloride	2.00E-05	1	0	1	1	2.94E-01	1.90E+00

```
+------------------------------------+
|Enter Receptor Names:               |
|                                    |
|Receptor #1:                        |
|Receptor #2:                        |
|Receptor #3:         Adult          |
+------------------------------------+


Assumptions for
Carcinogenic Assessment
Risk By Inhalation and Ingestion Of Chemicals In Air (NE-1 Basement Site-specic Subchr  Assumed Value (units)
========================================================================          ====================================
Inhalation Rate                                                                         NA (m3 air/day)
Inhalation Rate                                                                         NA (m3 air/day)
Inhalation Rate                  Adult                                                  15 (m3 air/day)
Body Weight                                                                             70 (kg)
Body Weight                                                                             70 (kg)
Body Weight                      Adult                                                  70 (kg)
Exposure Time                                                                           NA (hrs)/24 (hrs) =    0.00E+00
Exposure Time                                                                           NA (hrs)/24 (hrs) =    0.00E+00
Exposure Time                    Adult                                                0.71 (hrs)/24 (hrs) =    2.96E-02
Exposure Frequency                                                                      NA (days)/365 (days) = 0.00E+00
Exposure Frequency                                                                      NA (days)/365 (days) = 0.00E+00
Exposure Frequency               Adult                                                 350 (days)/365 (days) = 9.59E-01
Exposure Duration                                                                       NA (yrs)/ 30 (yrs) =   0.00E+00
Exposure Duration                                                                       NA (yrs)/ 30 (yrs) =   0.00E+00
Exposure Duration                Adult                                                   1 (yrs)/ 70 (yrs) =   1.43E-02
90th percentile residential                                                             70 (years)
```

```
                        Potential Carcinogenic Risk Associated With Potential Inhalation And Ingestion Of Chemicals In Air


The average daily dose (ADD) from inhalation of air is calculated for each receptor using the following equation:
              ADDinh =  Chemical       * Inhalation    * Lung         * Exposure       * Exposure       * Inhalation          / Body
            (mg/kg-day) Concentration    Rate            Retention      Time Per         Frequency        Absorption            Weight
                        In Air           (m3 air/day)    Factor         24 Hours         Per 365 Days     Adjustment            (kg)
                        (mg/m3 air)                                     (hours/hours)    (day/day)        Factor

The average daily dose (ADD) from ingestion of entrained particles in air is calculated using the following equation:
              ADDing =  Chemical       * Inhalation    * Inhaled      * Exposure       * Exposure       * Oral                / Body
            (mg/kg-day) Concentration    Rate            Particle       Time Per         Frequency        Absorption            Weight
                        In Air           (m3 air/day)    Ingestion      24 Hours         Per 365 Days     Adjustment            (kg)
                        (mg/m3 air)                      Factor         (hours/hours)    (day/day)        Factor

The lifetime average daily dose (LADD) is calculated for each pathway using the following equation, where:

Receptor #1 (R1) =
Receptor #2 (R2) =
Receptor #3 (R3) =      Adult



Averaging Time =        AT             Where: AT = Exposure Duration/Lifetime
                                                   (years)        (years)
                LADD =  (ADD,R1 * AT,R1)  +  (ADD,R2 * AT,R2)  +  (ADD,R3 * AT,R3)
            (mg/kg-day) (mg/kg-day)           (mg/kg-day)           (mg/kg-day)

The excess lifetime cancer risk associated with inhalation is calculated using the following equation:
     Excess Lifetime =  LADDinhalation * Inhalation Cancer Slope Factor
         Cancer Risk    (mg/kg-day)      ((mg/kg-day)^1)

The excess lifetime cancer risk associated with ingestion of entrained particles is calculated using the following equation:
     Excess Lifetime =  LADDingestion  * Oral Cancer Slope Factor
         Cancer Risk    (mg/kg-day)      ((mg/kg-day)^1)

The total excess lifetime cancer risk is calculated using the following equation:
         Total Excess = Excess Lifetime Cancer Risk (inhalation) + Excess Lifetime Cancer Risk (ingestion)
Lifetime Cancer Risk


========================================================================================================================================================================
```

Inhalation - Chronic Exposures
Carcinogenic Assessment
Adult

CHEMICAL	Chemical Concentration In Air (mg/m3 air)	Inhalation Rate (m3 air/day)	Lung Retention Factor	Exposure Time Per 24 Hours (hours/hours)	Exposure Frequency Per 365 Days (day/day)	Inhalation Absorption Adjustment Factor	Body Weight (kg)	Average Daily Dose (mg/kg-day)
Tetrachloroethene	8.21E-02	15.0	1	2.96E-02	9.59E-01	1	70	4.99E-04
Trichloroethene	1.50E-03	15.0	1	2.96E-02	9.59E-01	0.35	70	3.19E-06
trans-1,2-Dichloroethene	1.60E-04	15.0	1	2.96E-02	9.59E-01	1	70	9.73E-07
cis-1,2-Dichloroethene	2.60E-04	15.0	1	2.96E-02	9.59E-01	1	70	1.58E-06
Vinyle Chloride	2.00E-05	15.0	1	2.96E-02	9.59E-01	1	70	1.22E-07

POTENTIAL CARCINOGENIC RISK ASSOCIATED WITH INHALATION OF AIR

CHEMICAL	Average Daily Dose From Potential Inhalation Of Air				Adult ADDinhalation (mg/kg-day)	Averaging Time Adult (years/years)	Lifetime ADDinhalation (mg/kg-day)	Inhalation Cancer Slope Factor ((mg/kg-day)^-1)	Excess Lifetime Cancer Risk Inhalation
	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	ADDinhalation (mg/kg-day)	Averaging Time (years/years)					
Tetrachloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.99E-04	1.43E-02	7.13E-06	1.82E-03	1.30E-08
Trichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.19E-06	1.43E-02	4.56E-08	1.70E-02	7.75E-10
trans-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.73E-07	1.43E-02	1.39E-08	ND	ND
cis-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.58E-06	1.43E-02	2.26E-08	ND	ND
Vinyle Chloride	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.22E-07	1.43E-02	1.74E-09	2.94E-01	5.11E-10

POTENTIAL CARCINOGENIC RISK ASSOCIATED WITH INHALATION AND INGESTION OF CHEMICALS IN AIR

CHEMICAL	Excess Lifetime Cancer Risk Inhalation	Excess Lifetime Cancer Risk Ingestion	Total Excess Lifetime Cancer Risk
Tetrachloroethene	1.30E-08	0.00E+00	1.30E-08
Trichloroethene	7.75E-10	0.00E+00	7.75E-10
trans-1,2-Dichloroethene	ND	ND	ND
cis-1,2-Dichloroethene	ND	ND	ND
Vinyle Chloride	5.11E-10	0.00E+00	5.11E-10
Total =	1.43E-08	0.00E+00	1.43E-08

NE-1C.WQ1 25-Mar-92 R.N.: 01

SOURCE: ENSR 1990

Risk Assessment Calculations
Carcinogenic Assessment
Subchronic 24 Hour Basement Exposure

Carcinogenic Assessment
Risk By Inhalation and Ingestion Of Chemicals In Air (NE-1 Basement 24-Hour Subchronic Residential Exposure)

CHEMICAL-RELATED VARIABLES Chemical	Chemical Concentration In Air (mg/m3 air)	Lung Retention Factor	Inhaled Particle Ingestion Factor	Inhalation Absorption Adjustment Factor	Oral Absorption Adjustment Factor	Inhalation Cancer Slope Factor ((mg/kg-day)^-1)	Oral Cancer Slope Factor ((mg/kg-day)^-1)
Tetrachloroethene	8.21E-02	1	0	1	1	1.82E-03	5.10E-02
Trichloroethene	1.50E-03	1	0	0.35	1	1.70E-02	1.10E-02
trans-1,2-Dichloroethene	1.60E-04	1	0	1	1	ND	ND
cis-1,2-Dichloroethene	2.60E-04	1	0	1	1	ND	ND
Vinyle Chloride	2.00E-05	1	0	1	1	2.94E-01	1.90E+00

```
+-------------------------------------+
|Enter Receptor Names:                |
|                                     |
|Receptor #1:                         |
|Receptor #2:                         |
|Receptor #3:          Adult          |
+-------------------------------------+


Assumptions for
Carcinogenic Assessment
Risk By Inhalation and Ingestion Of Chemicals In Air (NE-1 Basement 24-Hour Subchronic  Assumed Value (units)
=====================================================================          ===================================
Inhalation Rate                                                     NA (m3 air/day)
Inhalation Rate                                                     NA (m3 air/day)
Inhalation Rate                 Adult                               15 (m3 air/day)
Body Weight                                                         70 (kg)
Body Weight                                                         70 (kg)
Body Weight                     Adult                               70 (kg)
Exposure Time                                                       NA (hrs)/24 (hrs) =    0.00E+00
Exposure Time                                                       NA (hrs)/24 (hrs) =    0.00E+00
Exposure Time                   Adult                               24 (hrs)/24 (hrs) =    1.00E+00
Exposure Frequency                                                  NA (days)/365 (days) = 0.00E+00
Exposure Frequency                                                  NA (days)/365 (days) = 0.00E+00
Exposure Frequency              Adult                              350 (days)/365 (days) = 9.59E-01
Exposure Duration                                                   NA (yrs)/ 30 (yrs) =   0.00E+00
Exposure Duration                                                   NA (yrs)/ 30 (yrs) =   0.00E+00
Exposure Duration               Adult                                1 (yrs)/ 70 (yrs) =   1.43E-02
90th percentile residential                                         70 (years)
```

Potential Carcinogenic Risk Associated With Potential Inhalation And Ingestion Of Chemicals In Air

The average daily dose (ADD) from inhalation of air is calculated for each receptor using the following equation:

```
           ADDinh =  Chemical       * Inhalation    * Lung         * Exposure       * Exposure       * Inhalation       / Body
        (mg/kg-day) Concentration     Rate            Retention      Time Per         Frequency        Absorption         Weight
                     In Air           (m3 air/day)    Factor         24 Hours         Per 365 Days     Adjustment         (kg)
                     (mg/m3 air)                                     (hours/hours)    (day/day)        Factor
```

The average daily dose (ADD) from ingestion of entrained particles in air is calculated using the following equation:

```
           ADDing =  Chemical       * Inhalation    * Inhaled      * Exposure       * Exposure       * Oral             / Body
        (mg/kg-day) Concentration     Rate            Particle       Time Per         Frequency        Absorption         Weight
                     In Air           (m3 air/day)    Ingestion      24 Hours         Per 365 Days     Adjustment         (kg)
                     (mg/m3 air)                      Factor         (hours/hours)    (day/day)        Factor
```

The lifetime average daily dose (LADD) is calculated for each pathway using the following equation, where:

```
Receptor #1 (R1) =
Receptor #2 (R2) =
Receptor #3 (R3) =      Adult
```

```
Averaging Time =        AT              Where: AT = Exposure Duration/Lifetime
                                                      (years)       (years)
             LADD =  (ADD,R1 * AT,R1)  +  (ADD,R2 * AT,R2)  +  (ADD,R3 * AT,R3)
        (mg/kg-day) (mg/kg-day)           (mg/kg-day)           (mg/kg-day)
```

The excess lifetime cancer risk associated with inhalation is calculated using the following equation:

```
     Excess Lifetime =  LADDinhalation * Inhalation Cancer Slope Factor
         Cancer Risk    (mg/kg-day)      ((mg/kg-day)^1)
```

The excess lifetime cancer risk associated with ingestion of entrained particles is calculated using the following equation:

```
     Excess Lifetime =  LADDingestion  * Oral Cancer Slope Factor
         Cancer Risk    (mg/kg-day)      ((mg/kg-day)^1)
```

The total excess lifetime cancer risk is calculated using the following equation:

```
         Total Excess = Excess Lifetime Cancer Risk (inhalation) + Excess Lifetime Cancer Risk (ingestion)
Lifetime Cancer Risk
```

Inhalation - Chronic Exposures
Carcinogenic Assessment
Adult

CHEMICAL	Chemical Concentration In Air (mg/m3 air)	Inhalation Rate (m3 air/day)	Lung Retention Factor	Exposure Time Per 24 Hours (hours/hours)	Exposure Frequency Per 365 Days (day/day)	Inhalation Absorption Adjustment Factor	Body Weight (kg)	Average Daily Dose (mg/kg-day)
Tetrachloroethene	8.21E-02	15.0	1	1.00E+00	9.59E-01	1	70	1.69E-02
Trichloroethene	1.50E-03	15.0	1	1.00E+00	9.59E-01	0.35	70	1.08E-04
trans-1,2-Dichloroethene	1.60E-04	15.0	1	1.00E+00	9.59E-01	1	70	3.29E-05
cis-1,2-Dichloroethene	2.60E-04	15.0	1	1.00E+00	9.59E-01	1	70	5.34E-05
Vinyle Chloride	2.00E-05	15.0	1	1.00E+00	9.59E-01	1	70	4.11E-06

POTENTIAL CARCINOGENIC RISK ASSOCIATED WITH INHALATION OF AIR

	Average Daily Dose From Potential Inhalation Of Air								
CHEMICAL	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	Adult ADDinhalation (mg/kg-day)	Averaging Time Adult (years/years)	Lifetime ADDinhalation (mg/kg-day)	Inhalation Cancer Slope Factor ((mg/kg-day)^-1)	Excess Lifetime Cancer Risk Inhalation
Tetrachloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.69E-02	1.43E-02	2.41E-04	1.82E-03	4.39E-07
Trichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.08E-04	1.43E-02	1.54E-06	1.70E-02	2.62E-08
trans-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.29E-05	1.43E-02	4.70E-07	ND	ND
cis-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.34E-05	1.43E-02	7.63E-07	ND	ND
Vinyle Chloride	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.11E-06	1.43E-02	5.87E-08	2.94E-01	1.73E-08

POTENTIAL CARCINOGENIC RISK ASSOCIATED WITH INHALATION AND INGESTION OF CHEMICALS IN AIR

CHEMICAL	Excess Lifetime Cancer Risk Inhalation	Excess Lifetime Cancer Risk Ingestion	Total Excess Lifetime Cancer Risk
Tetrachloroethene	4.39E-07	0.00E+00	4.39E-07
Trichloroethene	2.62E-08	0.00E+00	2.62E-08
trans-1,2-Dichloroethene	ND	ND	ND
cis-1,2-Dichloroethene	ND	ND	ND
Vinyle Chloride	1.73E-08	0.00E+00	1.73E-08
Total =	4.82E-07	0.00E+00	4.82E-07

NE-1C.WQ1 25-Mar-92 R.N.: 00

SOURCE: ENSR 1990

Risk Assessment Calculations
Carcinogenic Assessment
Chronic 24 Hour Upstairs Exposure

Carcinogenic Assessment
Risk By Inhalation and Ingestion Of Chemicals In Air (NE-1 Upstairs 24-Hour Chronic Residential Exposure)

CHEMICAL-RELATED VARIABLES Chemical	Chemical Concentration In Air (mg/m3 air)	Lung Retention Factor	Inhaled Particle Ingestion Factor	Inhalation Absorption Adjustment Factor	Oral Absorption Adjustment Factor	Inhalation Cancer Slope Factor ((mg/kg-day)^-1)	Oral Cancer Slope Factor ((mg/kg-day)^-1)
Tetrachloroethene	2.79E-02	1	0	1	1	1.82E-03	5.10E-02
Trichloroethene	6.00E-04	1	0	0.35	1	1.70E-02	1.10E-02
trans-1,2-Dichloroethene	1.80E-04	1	0	1	1	ND	ND
cis-1,2-Dichloroethene	1.80E-04	1	0	1	1	ND	ND
Vinyle Chloride	2.00E-05	1	0	1	1	2.94E-01	1.90E+00

```
+---------------------------------------+
|Enter Receptor Names:                  |
|                                       |
|Receptor #1:                           |
|Receptor #2:                           |
|Receptor #3:          Adult            |
+---------------------------------------+


Assumptions for
Carcinogenic Assessment
Risk By Inhalation and Ingestion Of Chemicals In Air (NE-1 Upstairs 24-Hour Chronic Re  Assumed Value (units)
======================================================================          ====================================
Inhalation Rate                                                                      NA (m3 air/day)
Inhalation Rate                                                                      NA (m3 air/day)
Inhalation Rate                  Adult                                               15 (m3 air/day)
Body Weight                                                                          70 (kg)
Body Weight                                                                          70 (kg)
Body Weight                      Adult                                               70 (kg)
Exposure Time                                                                        NA (hrs)/24 (hrs) =     0.00E+00
Exposure Time                                                                        NA (hrs)/24 (hrs) =     0.00E+00
Exposure Time                    Adult                                               24 (hrs)/24 (hrs) =     1.00E+00
Exposure Frequency                                                                   NA (days)/365 (days) = 0.00E+00
Exposure Frequency                                                                   NA (days)/365 (days) = 0.00E+00
Exposure Frequency               Adult                                              350 (days)/365 (days) = 9.59E-01
Exposure Duration                                                                    NA (yrs)/ 30 (yrs) =    0.00E+00
Exposure Duration                                                                    NA (yrs)/ 30 (yrs) =    0.00E+00
Exposure Duration                Adult                                               30 (yrs)/ 70 (yrs) =    4.29E-01
90th percentile residential                                                          70 (years)
```

```
                     Potential Carcinogenic Risk Associated With Potential Inhalation And Ingestion Of Chemicals In Air

The average daily dose (ADD) from inhalation of air is calculated for each receptor using the following equation:
          ADDinh =  Chemical       * Inhalation   * Lung         * Exposure      * Exposure      * Inhalation      / Body
        (mg/kg-day) Concentration    Rate           Retention      Time Per        Frequency       Absorption        Weight
                    In Air           (m3 air/day)   Factor         24 Hours        Per 365 Days    Adjustment        (kg)
                    (mg/m3 air)                                    (hours/hours)   (day/day)       Factor

The average daily dose (ADD) from ingestion of entrained particles in air is calculated using the following equation:
          ADDing =  Chemical       * Inhalation   * Inhaled      * Exposure      * Exposure      * Oral            / Body
        (mg/kg-day) Concentration    Rate           Particle       Time Per        Frequency       Absorption        Weight
                    In Air           (m3 air/day)   Ingestion      24 Hours        Per 365 Days    Adjustment        (kg)
                    (mg/m3 air)                     Factor         (hours/hours)   (day/day)       Factor

The lifetime average daily dose (LADD) is calculated for each pathway using the following equation, where:

Receptor #1 (R1) =
Receptor #2 (R2) =
Receptor #3 (R3) =      Adult



Averaging Time =        AT            Where: AT = Exposure Duration/Lifetime
                                                    (years)        (years)
            LADD =  (ADD,R1 * AT,R1)  +  (ADD,R2 * AT,R2)  +  (ADD,R3 * AT,R3)
        (mg/kg-day) (mg/kg-day)           (mg/kg-day)           (mg/kg-day)

The excess lifetime cancer risk associated with inhalation is calculated using the following equation:
     Excess Lifetime =  LADDinhalation * Inhalation Cancer Slope Factor
         Cancer Risk    (mg/kg-day)      ((mg/kg-day)^1)

The excess lifetime cancer risk associated with ingestion of entrained particles is calculated using the following equation:
     Excess Lifetime =  LADDingestion  * Oral Cancer Slope Factor
         Cancer Risk    (mg/kg-day)      ((mg/kg-day)^1)

The total excess lifetime cancer risk is calculated using the following equation:
         Total Excess = Excess Lifetime Cancer Risk (inhalation) + Excess Lifetime Cancer Risk (ingestion)
Lifetime Cancer Risk


====================================================================================================================
```

Inhalation - Chronic Exposures
Carcinogenic Assessment
Adult

CHEMICAL	Chemical Concentration In Air (mg/m3 air)	Inhalation Rate (m3 air/day)	Lung Retention Factor	Exposure Time Per 24 Hours (hours/hours)	Exposure Frequency Per 365 Days (day/day)	Inhalation Absorption Adjustment Factor	Body Weight (kg)	Average Daily Dose (mg/kg-day)
Tetrachloroethene	2.79E-02	15.0	1	1.00E+00	9.59E-01	1	70	5.73E-03
Trichloroethene	6.00E-04	15.0	1	1.00E+00	9.59E-01	0.35	70	4.32E-05
trans-1,2-Dichloroethene	1.80E-04	15.0	1	1.00E+00	9.59E-01	1	70	3.70E-05
cis-1,2-Dichloroethene	1.80E-04	15.0	1	1.00E+00	9.59E-01	1	70	3.70E-05
Vinyle Chloride	2.00E-05	15.0	1	1.00E+00	9.59E-01	1	70	4.11E-06

POTENTIAL CARCINOGENIC RISK ASSOCIATED WITH INHALATION OF AIR

Average Daily Dose From Potential Inhalation Of Air

CHEMICAL	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	Adult ADDinhalation (mg/kg-day)	Averaging Time Adult (years/years)	Lifetime ADDinhalation (mg/kg-day)	Inhalation Cancer Slope Factor ((mg/kg-day)^-1)	Excess Lifetime Cancer Risk Inhalation
Tetrachloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.73E-03	4.29E-01	2.46E-03	1.82E-03	4.47E-06
Trichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.32E-05	4.29E-01	1.85E-05	1.70E-02	3.14E-07
trans-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.70E-05	4.29E-01	1.59E-05	ND	ND
cis-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.70E-05	4.29E-01	1.59E-05	ND	ND
Vinyle Chloride	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.11E-06	4.29E-01	1.76E-06	2.94E-01	5.18E-07

POTENTIAL CARCINOGENIC RISK ASSOCIATED WITH INHALATION AND INGESTION OF CHEMICALS IN AIR

CHEMICAL	Excess Lifetime Cancer Risk Inhalation	Excess Lifetime Cancer Risk Ingestion	Total Excess Lifetime Cancer Risk
Tetrachloroethene	4.47E-06	0.00E+00	4.47E-06
Trichloroethene	3.14E-07	0.00E+00	3.14E-07
trans-1,2-Dichloroethene	ND	ND	ND
cis-1,2-Dichloroethene	ND	ND	ND
Vinyle Chloride	5.18E-07	0.00E+00	5.18E-07
Total =	5.30E-06	0.00E+00	5.30E-06

NE-1C.WQ1 25-Mar-92 R.N.: 01

SOURCE: ENSR 1990

Risk Assessment Calculations
Carcinogenic Assessment
Subchronic 24 Hour Upstairs Exposure

Carcinogenic Assessment
Risk By Inhalation and Ingestion Of Chemicals In Air (NE-1 Upstairs 24-Hour Subchronic Residential Exposure)

CHEMICAL-RELATED VARIABLES Chemical	Chemical Concentration In Air (mg/m3 air)	Lung Retention Factor	Inhaled Particle Ingestion Factor	Inhalation Absorption Adjustment Factor	Oral Absorption Adjustment Factor	Inhalation Cancer Slope Factor ((mg/kg-day)^-1)	Oral Cancer Slope Factor ((mg/kg-day)^-1)
Tetrachloroethene	2.79E-02	1	0	1	1	1.82E-03	5.10E-02
Trichloroethene	6.00E-04	1	0	0.35	1	1.70E-02	1.10E-02
trans-1,2-Dichloroethene	1.80E-04	1	0	1	1	ND	ND
cis-1,2-Dichloroethene	1.80E-04	1	0	1	1	ND	ND
Vinyle Chloride	2.00E-05	1	0	1	1	2.94E-01	1.90E+00

```
+---------------------------------------+
|Enter Receptor Names:                  |
|                                       |
|Receptor #1:                           |
|Receptor #2:                           |
|Receptor #3:           Adult           |
+---------------------------------------+


Assumptions for
Carcinogenic Assessment
Risk By Inhalation and Ingestion Of Chemicals In Air (NE-1 Upstairs 24-Hour Subchronic  Assumed Value (units)
======================================================================          ====================================
Inhalation Rate                                                                    NA (m3 air/day)
Inhalation Rate                                                                    NA (m3 air/day)
Inhalation Rate                 Adult                                              15 (m3 air/day)
Body Weight                                                                        70 (kg)
Body Weight                                                                        70 (kg)
Body Weight                     Adult                                              70 (kg)
Exposure Time                                                                      NA (hrs)/24 (hrs) =    0.00E+00
Exposure Time                                                                      NA (hrs)/24 (hrs) =    0.00E+00
Exposure Time                   Adult                                              24 (hrs)/24 (hrs) =    1.00E+00
Exposure Frequency                                                                 NA (days)/365 (days) = 0.00E+00
Exposure Frequency                                                                 NA (days)/365 (days) = 0.00E+00
Exposure Frequency              Adult                                             350 (days)/365 (days) = 9.59E-01
Exposure Duration                                                                  NA (yrs)/ 30 (yrs) =   0.00E+00
Exposure Duration                                                                  NA (yrs)/ 30 (yrs) =   0.00E+00
Exposure Duration               Adult                                               1 (yrs)/ 70 (yrs) =   1.43E-02
90th percentile residential                                                        70 (years)
```

Potential Carcinogenic Risk Associated With Potential Inhalation And Ingestion Of Chemicals In Air

```
The average daily dose (ADD) from inhalation of air is calculated for each receptor using the following equation:
           ADDinh =  Chemical        * Inhalation    * Lung          * Exposure      * Exposure      * Inhalation      / Body
         (mg/kg-day) Concentration     Rate            Retention       Time Per        Frequency       Absorption        Weight
                     In Air            (m3 air/day)    Factor          24 Hours        Per 365 Days    Adjustment        (kg)
                     (mg/m3 air)                                       (hours/hours)   (day/day)       Factor

The average daily dose (ADD) from ingestion of entrained particles in air is calculated using the following equation:
           ADDing =  Chemical        * Inhalation    * Inhaled       * Exposure      * Exposure      * Oral            / Body
         (mg/kg-day) Concentration     Rate            Particle        Time Per        Frequency       Absorption        Weight
                     In Air            (m3 air/day)    Ingestion       24 Hours        Per 365 Days    Adjustment        (kg)
                     (mg/m3 air)                       Factor          (hours/hours)   (day/day)       Factor

The lifetime average daily dose (LADD) is calculated for each pathway using the following equation, where:

Receptor #1 (R1) =
Receptor #2 (R2) =
Receptor #3 (R3) =       Adult



Averaging Time =         AT            Where: AT = Exposure Duration/Lifetime
                                                     (years)        (years)
                LADD =  (ADD,R1 * AT,R1)  +  (ADD,R2 * AT,R2)  +  (ADD,R3 * AT,R3)
            (mg/kg-day) (mg/kg-day)           (mg/kg-day)           (mg/kg-day)

The excess lifetime cancer risk associated with inhalation is calculated using the following equation:
     Excess Lifetime =  LADDinhalation * Inhalation Cancer Slope Factor
         Cancer Risk    (mg/kg-day)      ((mg/kg-day)^1)

The excess lifetime cancer risk associated with ingestion of entrained particles is calculated using the following equation:
     Excess Lifetime =  LADDingestion  * Oral Cancer Slope Factor
         Cancer Risk    (mg/kg-day)      ((mg/kg-day)^1)

The total excess lifetime cancer risk is calculated using the following equation:
         Total Excess = Excess Lifetime Cancer Risk (inhalation) + Excess Lifetime Cancer Risk (ingestion)
Lifetime Cancer Risk
```

Inhalation - Chronic Exposures
Carcinogenic Assessment
Adult

CHEMICAL	Chemical Concentration In Air (mg/m3 air)	Inhalation Rate (m3 air/day)	Lung Retention Factor	Exposure Time Per 24 Hours (hours/hours)	Exposure Frequency Per 365 Days (day/day)	Inhalation Absorption Adjustment Factor	Body Weight (kg)	Average Daily Dose (mg/kg-day)
Tetrachloroethene	2.79E-02	15.0	1	1.00E+00	9.59E-01	1	70	5.73E-03
Trichloroethene	6.00E-04	15.0	1	1.00E+00	9.59E-01	0.35	70	4.32E-05
trans-1,2-Dichloroethene	1.80E-04	15.0	1	1.00E+00	9.59E-01	1	70	3.70E-05
cis-1,2-Dichloroethene	1.80E-04	15.0	1	1.00E+00	9.59E-01	1	70	3.70E-05
Vinyle Chloride	2.00E-05	15.0	1	1.00E+00	9.59E-01	1	70	4.11E-06

POTENTIAL CARCINOGENIC RISK ASSOCIATED WITH INHALATION OF AIR

Average Daily Dose From Potential Inhalation Of Air

CHEMICAL	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	Adult ADDinhalation (mg/kg-day)	Averaging Time Adult (years/years)	Lifetime ADDinhalation (mg/kg-day)	Inhalation Cancer Slope Factor ((mg/kg-day)^-1)	Excess Lifetime Cancer Risk Inhalation
Tetrachloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.73E-03	1.43E-02	8.19E-05	1.82E-03	1.49E-07
Trichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.32E-05	1.43E-02	6.16E-07	1.70E-02	1.05E-08
trans-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.70E-05	1.43E-02	5.28E-07	ND	ND
cis-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.70E-05	1.43E-02	5.28E-07	ND	ND
Vinyle Chloride	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.11E-06	1.43E-02	5.87E-08	2.94E-01	1.73E-08

POTENTIAL CARCINOGENIC RISK ASSOCIATED WITH INHALATION AND INGESTION OF CHEMICALS IN AIR

CHEMICAL	Excess Lifetime Cancer Risk Inhalation	Excess Lifetime Cancer Risk Ingestion	Total Excess Lifetime Cancer Risk
Tetrachloroethene	1.49E-07	0.00E+00	1.49E-07
Trichloroethene	1.05E-08	0.00E+00	1.05E-08
trans-1,2-Dichloroethene	ND	ND	ND
cis-1,2-Dichloroethene	ND	ND	ND
Vinyle Chloride	1.73E-08	0.00E+00	1.73E-08
Total =	1.77E-07	0.00E+00	1.77E-07

NE-1C.WQ1 25-Mar-92 R.N.: 01

SOURCE: ENSR 1990

Risk Assessment Calculations
Noncarcinogenic Assessment
Chronic Site-Specific Time in Basement

Noncarcinogenic Assessment
Exposure By Inhalation and Ingestion Of Chemicals In Air (Basement Site-specific Chronic Residential Exposure)

CHEMICAL-RELATED VARIABLES Chemical	Chemical Concentration In Air (mg/m3 air)	Lung Retention Factor	Inhaled Particle Ingestion Factor	Inhalation Absorption Adjustment Factor	Oral Absorption Adjustment Factor	Inhalation Reference Dose (mg/kg-day)	Oral Reference Dose (mg/kg-day)
Tetrachloroethene	8.21E-02	1	0	1	1	1.00E-02	1.00E-02
Trichloroethene	1.50E-03	1	0	0.35	1	ND	ND
trans-1,2-Dichloroethene	1.60E-04	1	0	1	1	2.00E-02	2.00E-02
cis-1,2-Dichloroethene	2.60E-04	1	0	1	1	1.00E-02	1.00E-02
Vinyle Chloride	2.00E-05	1	0	1	1	ND	ND

```
+----------------------------------------+
|Enter Receptor Names:                   |
|                                        |
|Receptor #1:                            |
|Receptor #2:                            |
|Receptor #3:          Adult             |
+----------------------------------------+


Assumptions for
Noncarcinogenic Assessment
Exposure By Inhalation and Ingestion Of Chemicals In Air (Basement Site-specific Chronic RAssumed Value   (units)
======================================================================           ================================
Inhalation Rate                                                                      NA (m3 air/day)
Inhalation Rate                                                                      NA (m3 air/day)
Inhalation Rate                  Adult                                               15 (m3 air/day)
Body Weight                                                                          70 (kg)
Body Weight                                                                          70 (kg)
Body Weight                      Adult                                               70 (kg)
Exposure Time                                                                        NA (hrs)/24 hrs) =  0.00E+00
Exposure Time                                                                        NA (hrs)/24 hrs) =  0.00E+00
Exposure Time                    Adult                                             0.71 (hrs)/24 hrs) =  2.96E-02
Exposure Frequency                                                                   NA (days)/365 days =0.00E+00
Exposure Frequency                                                                   NA (days)/365 days =0.00E+00
Exposure Frequency               Adult                                              350 (days)/365 days =9.59E-01
Exposure Duration                                                                    NA (yrs)/69 (yrs) = 0.00E+00
Exposure Duration                                                                    NA (yrs)/69 (yrs) = 0.00E+00
Exposure Duration                Adult                                               30 (yrs)/69 (yrs) = 1.00E+00
Total Exposure Duration                                                              30 (years)
```

Potential Noncarcinogenic Hazard Index Associated With Potential Inhalation And Ingestion Of Chemicals In Air

```
The average daily dose (ADD) from inhalation of air is calculated for each receptor using the following equation:
          ADDinh =  Chemical        * Inhalation   * Lung          * Exposure       * Exposure      * Inhalation    / Body
       (mg/kg-day) Concentration      Rate           Retention       Time Per         Frequency       Absorption      Weight
                    In Air            (m3 air/day)   Factor          24 Hours         Per 365 Days    Adjustment      (kg)
                    (mg/m3 air)                                      (hours/hours)    (day/day)       Factor

The average daily dose (ADD) from ingestion of entrained particles in air is calculated using the following equation:
          ADDing =  Chemical        * Inhalation   * Inhaled       * Exposure       * Exposure      * Oral          / Body
       (mg/kg-day) Concentration      Rate           Particle        Time Per         Frequency       Absorption      Weight
                    In Air            (m3 air/day)   Ingestion       24 Hours         Per 365 Days    Adjustment      (kg)
                    (mg/m3 air)                      Factor          (hours/hours)    (day/day)       Factor

The chronic average daily dose (CADD) is calculated for each pathway using the following equation, where:

Receptor #1 (R1) =
Receptor #2 (R2) =
Receptor #3 (R3) =      Adult



Averaging Time =        AT               Where: AT = Exposure Duration/Total Exposure Duration
                                                        (year)          (year)
            CADD =  (ADD,R1 * AT,R1)  +  (ADD,R2 * AT,R2)  +  (ADD,R3 * AT,R3)
       (mg/kg-day) (mg/kg-day)           (mg/kg-day)          (mg/kg-day)

The hazard index associated with inhalation is calculated using the following equation:
       Hazard Index =  CADDInhalation  / Inhalation RfD
         inhalation    (mg/kg-day)       (mg/kg-day)

The hazard index associated with ingestion of entrained particles is calculated using the following equation:
       Hazard Index =  CADDIngestion   / Oral RfD
          ingestion    (mg/kg-day)       (mg/kg-day)

The total hazard index is calculated using the following equation:
            Total =  Hazard Index    + Hazard Index
       Hazard Index  Inhalation        Ingestion
```

Inhalation - Chronic Exposures
Noncarcinogenic Assessment
Adult

CHEMICAL	Chemical Concentration In Air (mg/m3 air)	Inhalation Rate (m3 air/day)	Lung Retention Factor	Exposure Time Per 24 Hours (hours/hours)	Exposure Frequency Per 365 Days (day/day)	Inhalation Absorption Adjustment Factor	Body Weight (kg)	Average Daily Dose (mg/kg-day)
Tetrachloroethene	8.21E-02	15.0	1	2.96E-02	9.59E-01	1	70	4.99E-04
Trichloroethene	1.50E-03	15.0	1	2.96E-02	9.59E-01	0.35	70	3.19E-06
trans-1,2-Dichloroethene	1.60E-04	15.0	1	2.96E-02	9.59E-01	1	70	9.73E-07
cis-1,2-Dichloroethene	2.60E-04	15.0	1	2.96E-02	9.59E-01	1	70	1.58E-06
Vinyle Chloride	2.00E-05	15.0	1	2.96E-02	9.59E-01	1	70	1.22E-07

POTENTIAL NONCARCINOGENIC HAZARD INDEX ASSOCIATED WITH INHALATION OF AIR

Average Daily Dose From Potential Inhalation Of Air

CHEMICAL	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	Adult ADDinhalation (mg/kg-day)	Averaging Time Adult (years/years)	Chronic ADDinhalation (mg/kg-day)	Inhalation Reference Dose (mg/kg-day)	Hazard Index Inhalation
Tetrachloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.99E-04	1.00E+00	4.99E-04	1.00E-02	4.99E-02
Trichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.19E-06	1.00E+00	3.19E-06	ND	ND
trans-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.73E-07	1.00E+00	9.73E-07	2.00E-02	4.86E-05
cis-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.58E-06	1.00E+00	1.58E-06	1.00E-02	1.58E-04
Vinyle Chloride	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.22E-07	1.00E+00	1.22E-07	ND	ND

POTENTIAL NONCARCINOGENIC HAZARD INDEX ASSOCIATED WITH INHALATION AND INGESTION OF CHEMICALS IN AIR

CHEMICAL	Hazard Index Inhalation	Hazard Index Ingestion	Total Hazard Index
Tetrachloroethene	4.99E-02	0.00E+00	4.99E-02
Trichloroethene	ND	0.00E+00	NA
trans-1,2-Dichloroethene	4.86E-05	0.00E+00	4.86E-05
cis-1,2-Dichloroethene	1.58E-04	0.00E+00	1.58E-04
Vinyle Chloride	ND	N.D.	N.D.
Total =	5.01E-02	0.00E+00	5.01E-02

NE-1NC.WQ1 25-Mar-92 R.N.: 02

SOURCE: ENSR 1990

Risk Assessment Calculations
Noncarcinogenic Assessment
Subchronic Site-Specific Time in Basement

Noncarcinogenic Assessment
Exposure By Inhalation and Ingestion Of Chemicals In Air (Site-specific Subchronic)

CHEMICAL-RELATED VARIABLES Chemical	Chemical Concentration In Air (mg/m3 air)	Lung Retention Factor	Inhaled Particle Ingestion Factor	Inhalation Absorption Adjustment Factor	Oral Absorption Adjustment Factor	Inhalation Reference Dose (mg/kg-day)	Oral Reference Dose (mg/kg-day)
Tetrachloroethene	8.21E-02	1	0	1	1	1.00E-01	1.00E-01
Trichloroethene	1.50E-03	1	0	0.35	1	ND	ND
trans-1,2-Dichloroethene	1.60E-04	1	0	1	1	2.00E-01	2.00E-01
cis-1,2-Dichloroethene	2.60E-04	1	0	1	1	1.00E-01	1.00E-01
Vinyle Chloride	2.00E-05	1	0	1	1	ND	ND

```
+---------------------------------------+
|Enter Receptor Names:                  |
|                                       |
|Receptor #1:                           |
|Receptor #2:                           |
|Receptor #3:           Adult           |
+---------------------------------------+


Assumptions for
Noncarcinogenic Assessment
Exposure By Inhalation and Ingestion Of Chemicals In Air (Site-specific Subchronic)      Assumed Value   (units)
=========================================================================                ================================
Inhalation Rate                                                                                NA (m3 air/day)
Inhalation Rate                                                                                NA (m3 air/day)
Inhalation Rate                   Adult                                                        15 (m3 air/day)
Body Weight                                                                                    70 (kg)
Body Weight                                                                                    70 (kg)
Body Weight                       Adult                                                        70 (kg)
Exposure Time                                                                                  NA (hrs)/24 hrs) =  0.00E+00
Exposure Time                                                                                  NA (hrs)/24 hrs) =  0.00E+00
Exposure Time                     Adult                                                      0.71 (hrs)/24 hrs) =  2.96E-02
Exposure Frequency                                                                             NA (days)/365 days =0.00E+00
Exposure Frequency                                                                             NA (days)/365 days =0.00E+00
Exposure Frequency                Adult                                                       350 (days)/365 days =9.59E-01
Exposure Duration                                                                              NA (yrs)/69 (yrs) = 0.00E+00
Exposure Duration                                                                              NA (yrs)/69 (yrs) = 0.00E+00
Exposure Duration                 Adult                                                         1 (yrs)/69 (yrs) = 1.00E+00
Total Exposure Duration                                                                         1 (years)
```

Potential Noncarcinogenic Hazard Index Associated With Potential Inhalation And Ingestion Of Chemicals In Air

The average daily dose (ADD) from inhalation of air is calculated for each receptor using the following equation:

```
      ADDinh =  Chemical        * Inhalation    * Lung          * Exposure        * Exposure      * Inhalation    / Body
    (mg/kg-day) Concentration     Rate            Retention       Time Per          Frequency       Absorption      Weight
                In Air            (m3 air/day)    Factor          24 Hours          Per 365 Days    Adjustment      (kg)
                (mg/m3 air)                                       (hours/hours)     (day/day)       Factor
```

The average daily dose (ADD) from ingestion of entrained particles in air is calculated using the following equation:

```
      ADDing =  Chemical        * Inhalation    * Inhaled       * Exposure        * Exposure      * Oral          / Body
    (mg/kg-day) Concentration     Rate            Particle        Time Per          Frequency       Absorption      Weight
                In Air            (m3 air/day)    Ingestion       24 Hours          Per 365 Days    Adjustment      (kg)
                (mg/m3 air)                       Factor          (hours/hours)     (day/day)       Factor
```

The chronic average daily dose (CADD) is calculated for each pathway using the following equation, where:

Receptor #1 (R1) =
Receptor #2 (R2) =
Receptor #3 (R3) = Adult

```
Averaging Time =        AT              Where: AT = Exposure Duration/Total Exposure Duration
                                                    (year)          (year)
          CADD =    (ADD,R1 * AT,R1)  +  (ADD,R2 * AT,R2)  +  (ADD,R3 * AT,R3)
      (mg/kg-day) (mg/kg-day)           (mg/kg-day)           (mg/kg-day)
```

The hazard index associated with inhalation is calculated using the following equation:

```
    Hazard Index =  CADDInhalation  / Inhalation RfD
     inhalation     (mg/kg-day)       (mg/kg-day)
```

The hazard index associated with ingestion of entrained particles is calculated using the following equation:

```
    Hazard Index =  CADDIngestion   / Oral RfD
      ingestion     (mg/kg-day)       (mg/kg-day)
```

The total hazard index is calculated using the following equation:

```
           Total =  Hazard Index    + Hazard Index
    Hazard Index    Inhalation        Ingestion
```

Inhalation - Chronic Exposures
Noncarcinogenic Assessment
Adult

CHEMICAL	Chemical Concentration In Air (mg/m3 air)	Inhalation Rate (m3 air/day)	Lung Retention Factor	Exposure Time Per 24 Hours (hours/hours)	Exposure Frequency Per 365 Days (day/day)	Inhalation Absorption Adjustment Factor	Body Weight (kg)	Average Daily Dose (mg/kg-day)
Tetrachloroethene	8.21E-02	15.0	1	2.96E-02	9.59E-01	1	70	4.99E-04
Trichloroethene	1.50E-03	15.0	1	2.96E-02	9.59E-01	0.35	70	3.19E-06
trans-1,2-Dichloroethene	1.60E-04	15.0	1	2.96E-02	9.59E-01	1	70	9.73E-07
cis-1,2-Dichloroethene	2.60E-04	15.0	1	2.96E-02	9.59E-01	1	70	1.58E-06
Vinyle Chloride	2.00E-05	15.0	1	2.96E-02	9.59E-01	1	70	1.22E-07

POTENTIAL NONCARCINOGENIC HAZARD INDEX ASSOCIATED WITH INHALATION OF AIR

Average Daily Dose From Potential Inhalation Of Air

CHEMICAL	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	Adult ADDinhalation (mg/kg-day)	Averaging Time Adult (years/years)	Chronic ADDinhalation (mg/kg-day)	Inhalation Reference Dose (mg/kg-day)	Hazard Index Inhalation
Tetrachloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.99E-04	1.00E+00	4.99E-04	1.00E-01	4.99E-03
Trichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.19E-06	1.00E+00	3.19E-06	ND	ND
trans-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.73E-07	1.00E+00	9.73E-07	2.00E-01	4.86E-06
cis-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.58E-06	1.00E+00	1.58E-06	1.00E-01	1.58E-05
Vinyle Chloride	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.22E-07	1.00E+00	1.22E-07	ND	ND

POTENTIAL NONCARCINOGENIC HAZARD INDEX ASSOCIATED WITH INHALATION AND INGESTION OF CHEMICALS IN AIR

CHEMICAL	Hazard Index Inhalation	Hazard Index Ingestion	Total Hazard Index
Tetrachloroethene	4.99E-03	0.00E+00	4.99E-03
Trichloroethene	ND	ND	ND
trans-1,2-Dichloroethene	4.86E-06	0.00E+00	4.86E-06
cis-1,2-Dichloroethene	1.58E-05	0.00E+00	1.58E-05
Vinyle Chloride	ND	N.D.	N.D.
Total =	5.01E-03	0.00E+00	5.01E-03

NE1SNC.WQ1 25-Mar-92 R.N.: 02

SOURCE: ENSR 1990

Risk Assessment Calculations
Noncarcinogenic Assessment
Subchronic 24 Hour Basement Exposure

Envirocon

Noncarcinogenic Assessment
Exposure By Inhalation and Ingestion Of Chemicals In Air (24-Hour Subchronic)

CHEMICAL-RELATED VARIABLES Chemical	Chemical Concentration In Air (mg/m3 air)	Lung Retention Factor	Inhaled Particle Ingestion Factor	Inhalation Absorption Adjustment Factor	Oral Absorption Adjustment Factor	Inhalation Reference Dose (mg/kg-day)	Oral Reference Dose (mg/kg-day)
Tetrachloroethene	8.21E-02	1	0	1	1	1.00E-01	1.00E-01
Trichloroethene	1.50E-03	1	0	0.35	1	ND	ND
trans-1,2-Dichloroethene	1.60E-04	1	0	1	1	2.00E-01	2.00E-01
cis-1,2-Dichloroethene	2.60E-04	1	0	1	1	1.00E-01	1.00E-01
Vinyle Chloride	2.00E-05	1	0	1	1	ND	ND

```
+-------------------------------------+
|Enter Receptor Names:                |
|                                     |
|Receptor #1:                         |
|Receptor #2:                         |
|Receptor #3:          Adult          |
+-------------------------------------+


Assumptions for
Noncarcinogenic Assessment
Exposure By Inhalation and Ingestion Of Chemicals In Air (24-Hour Subchronic)          Assumed Value   (units)
=====================================================================                  ===============================
Inhalation Rate                                                                                    NA (m3 air/day)
Inhalation Rate                                                                                    NA (m3 air/day)
Inhalation Rate                 Adult                                                              15 (m3 air/day)
Body Weight                                                                                        70 (kg)
Body Weight                                                                                        70 (kg)
Body Weight                     Adult                                                              70 (kg)
Exposure Time                                                                                      NA (hrs)/24 hrs) =  0.00E+00
Exposure Time                                                                                      NA (hrs)/24 hrs) =  0.00E+00
Exposure Time                   Adult                                                              24 (hrs)/24 hrs) =  1.00E+00
Exposure Frequency                                                                                 NA (days)/365 days =0.00E+00
Exposure Frequency                                                                                 NA (days)/365 days =0.00E+00
Exposure Frequency              Adult                                                             350 (days)/365 days =9.59E-01
Exposure Duration                                                                                  NA (yrs)/69 (yrs) = 0.00E+00
Exposure Duration                                                                                  NA (yrs)/69 (yrs) = 0.00E+00
Exposure Duration               Adult                                                               1 (yrs)/69 (yrs) = 1.00E+00
Total Exposure Duration                                                                             1 (years)
```

Potential Noncarcinogenic Hazard Index Associated With Potential Inhalation And Ingestion Of Chemicals In Air

The average daily dose (ADD) from inhalation of air is calculated for each receptor using the following equation:

```
      ADDinh =  Chemical        * Inhalation    * Lung          * Exposure        * Exposure        * Inhalation     / Body
   (mg/kg-day) Concentration     Rate            Retention       Time Per          Frequency         Absorption       Weight
                In Air            (m3 air/day)    Factor          24 Hours          Per 365 Days      Adjustment       (kg)
                (mg/m3 air)                                       (hours/hours)     (day/day)         Factor
```

The average daily dose (ADD) from ingestion of entrained particles in air is calculated using the following equation:

```
      ADDing =  Chemical        * Inhalation    * Inhaled       * Exposure        * Exposure        * Oral           / Body
   (mg/kg-day) Concentration     Rate            Particle        Time Per          Frequency         Absorption       Weight
                In Air            (m3 air/day)    Ingestion       24 Hours          Per 365 Days      Adjustment       (kg)
                (mg/m3 air)                       Factor          (hours/hours)     (day/day)         Factor
```

The chronic average daily dose (CADD) is calculated for each pathway using the following equation, where:

```
Receptor #1 (R1) =
Receptor #2 (R2) =
Receptor #3 (R3) =      Adult



Averaging Time =        AT              Where: AT = Exposure Duration/Total Exposure Duration
                                                        (year)         (year)
             CADD =  (ADD,R1 * AT,R1)  +  (ADD,R2 * AT,R2)  +  (ADD,R3 * AT,R3)
         (mg/kg-day) (mg/kg-day)           (mg/kg-day)          (mg/kg-day)
```

The hazard index associated with inhalation is calculated using the following equation:

```
       Hazard Index =  CADDInhalation  / Inhalation RfD
         inhalation    (mg/kg-day)       (mg/kg-day)
```

The hazard index associated with ingestion of entrained particles is calculated using the following equation:

```
       Hazard Index =  CADDIngestion   / Oral RfD
          ingestion    (mg/kg-day)       (mg/kg-day)
```

The total hazard index is calculated using the following equation:

```
              Total =  Hazard Index    + Hazard Index
       Hazard Index    Inhalation        Ingestion
```

==

Inhalation - Chronic Exposures
Noncarcinogenic Assessment
Adult

CHEMICAL	Chemical Concentration In Air (mg/m3 air)	Inhalation Rate (m3 air/day)	Lung Retention Factor	Exposure Time Per 24 Hours (hours/hours)	Exposure Frequency Per 365 Days (day/day)	Inhalation Absorption Adjustment Factor	Body Weight (kg)	Average Daily Dose (mg/kg-day)
Tetrachloroethene	8.21E-02	15.0	1	1.00E+00	9.59E-01	1	70	1.69E-02
Trichloroethene	1.50E-03	15.0	1	1.00E+00	9.59E-01	0.35	70	1.08E-04
trans-1,2-Dichloroethene	1.60E-04	15.0	1	1.00E+00	9.59E-01	1	70	3.29E-05
cis-1,2-Dichloroethene	2.60E-04	15.0	1	1.00E+00	9.59E-01	1	70	5.34E-05
Vinyle Chloride	2.00E-05	15.0	1	1.00E+00	9.59E-01	1	70	4.11E-06

POTENTIAL NONCARCINOGENIC HAZARD INDEX ASSOCIATED WITH INHALATION OF AIR

Average Daily Dose From Potential Inhalation Of Air

CHEMICAL	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	Adult ADDinhalation (mg/kg-day)	Averaging Time Adult (years/years)	Chronic ADDinhalation (mg/kg-day)	Inhalation Reference Dose (mg/kg-day)	Hazard Index Inhalation
Tetrachloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.69E-02	1.00E+00	1.69E-02	1.00E-01	1.69E-01
Trichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.08E-04	1.00E+00	1.08E-04	ND	ND
trans-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.29E-05	1.00E+00	3.29E-05	2.00E-01	1.64E-04
cis-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.34E-05	1.00E+00	5.34E-05	1.00E-01	5.34E-04
Vinyle Chloride	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.11E-06	1.00E+00	4.11E-06	ND	ND

POTENTIAL NONCARCINOGENIC HAZARD INDEX ASSOCIATED WITH INHALATION AND INGESTION OF CHEMICALS IN AIR

CHEMICAL	Hazard Index Inhalation	Hazard Index Ingestion	Total Hazard Index
Tetrachloroethene	1.69E-01	0.00E+00	1.69E-01
Trichloroethene	ND	ND	ND
trans-1,2-Dichloroethene	1.64E-04	0.00E+00	1.64E-04
cis-1,2-Dichloroethene	5.34E-04	0.00E+00	5.34E-04
Vinyle Chloride	ND	N.D.	N.D.
Total =	1.69E-01	0.00E+00	1.69E-01

NE1SNC.WQ1 25-Mar-92 R.N.: 02

SOURCE: ENSR 1990

Risk Assessment Calculations
Noncarcinogenic Assessment
Chronic 24 Hour Upstairs Exposure

R.N.: 02
Envirocon

Noncarcinogenic Assessment
Exposure By Inhalation and Ingestion Of Chemicals In Air (Upstairs 24-Hour Chronic Residential Exposure)

CHEMICAL-RELATED VARIABLES Chemical	Chemical Concentration In Air (mg/m3 air)	Lung Retention Factor	Inhaled Particle Ingestion Factor	Inhalation Absorption Adjustment Factor	Oral Absorption Adjustment Factor	Inhalation Reference Dose (mg/kg-day)	Oral Reference Dose (mg/kg-day)
Tetrachloroethene	2.79E-02	1	0	1	1	1.00E-02	1.00E-02
Trichloroethene	6.00E-04	1	0	0.35	1	ND	ND
trans-1,2-Dichloroethene	1.80E-04	1	0	1	1	2.00E-02	2.00E-02
cis-1,2-Dichloroethene	1.80E-04	1	0	1	1	1.00E-02	1.00E-02
Vinyle Chloride	2.00E-05	1	0	1	1	ND	ND

```
+---------------------------------------+
|Enter Receptor Names:                  |
|                                       |
|Receptor #1:                           |
|Receptor #2:                           |
|Receptor #3:          Adult            |
+---------------------------------------+


Assumptions for
Noncarcinogenic Assessment
Exposure By Inhalation and Ingestion Of Chemicals In Air (Upstairs 24-Hour Chronic ResidenAssumed Value   (units)
========================================================================         ================================
Inhalation Rate                                                                      NA (m3 air/day)
Inhalation Rate                                                                      NA (m3 air/day)
Inhalation Rate                  Adult                                               15 (m3 air/day)
Body Weight                                                                          70 (kg)
Body Weight                                                                          70 (kg)
Body Weight                      Adult                                               70 (kg)
Exposure Time                                                                        NA (hrs)/24 hrs) =  0.00E+00
Exposure Time                                                                        NA (hrs)/24 hrs) =  0.00E+00
Exposure Time                    Adult                                               24 (hrs)/24 hrs) =  1.00E+00
Exposure Frequency                                                                   NA (days)/365 days =0.00E+00
Exposure Frequency                                                                   NA (days)/365 days =0.00E+00
Exposure Frequency               Adult                                              350 (days)/365 days =9.59E-01
Exposure Duration                                                                    NA (yrs)/69 (yrs) = 0.00E+00
Exposure Duration                                                                    NA (yrs)/69 (yrs) = 0.00E+00
Exposure Duration                Adult                                               30 (yrs)/69 (yrs) = 1.00E+00
Total Exposure Duration                                                              30 (years)
```

Potential Noncarcinogenic Hazard Index Associated With Potential Inhalation And Ingestion Of Chemicals In Air

The average daily dose (ADD) from inhalation of air is calculated for each receptor using the following equation:

```
      ADDinh = Chemical         * Inhalation    * Lung          * Exposure         * Exposure       * Inhalation     / Body
 (mg/kg-day) Concentration        Rate            Retention       Time Per           Frequency        Absorption       Weight
             In Air               (m3 air/day)    Factor          24 Hours           Per 365 Days     Adjustment       (kg)
             (mg/m3 air)                                          (hours/hours)      (day/day)        Factor
```

The average daily dose (ADD) from ingestion of entrained particles in air is calculated using the following equation:

```
      ADDing = Chemical         * Inhalation    * Inhaled       * Exposure         * Exposure       * Oral           / Body
 (mg/kg-day) Concentration        Rate            Particle        Time Per           Frequency        Absorption       Weight
             In Air               (m3 air/day)    Ingestion       24 Hours           Per 365 Days     Adjustment       (kg)
             (mg/m3 air)                          Factor          (hours/hours)      (day/day)        Factor
```

The chronic average daily dose (CADD) is calculated for each pathway using the following equation, where:

```
Receptor #1 (R1) =
Receptor #2 (R2) =
Receptor #3 (R3) =      Adult



Averaging Time =        AT              Where: AT = Exposure Duration/Total Exposure Duration
                                                    (year)          (year)
           CADD =  (ADD,R1 * AT,R1)  +  (ADD,R2 * AT,R2)  +  (ADD,R3 * AT,R3)
     (mg/kg-day) (mg/kg-day)           (mg/kg-day)           (mg/kg-day)
```

The hazard index associated with inhalation is calculated using the following equation:

```
        Hazard Index = CADDInhalation  / Inhalation RfD
          inhalation   (mg/kg-day)       (mg/kg-day)
```

The hazard index associated with ingestion of entrained particles is calculated using the following equation:

```
        Hazard Index = CADDIngestion   / Oral RfD
           ingestion   (mg/kg-day)       (mg/kg-day)
```

The total hazard index is calculated using the following equation:

```
               Total = Hazard Index    + Hazard Index
        Hazard Index   Inhalation        Ingestion
```

Inhalation - Chronic Exposures
Noncarcinogenic Assessment
Adult

CHEMICAL	Chemical Concentration In Air (mg/m3 air)	Inhalation Rate (m3 air/day)	Lung Retention Factor	Exposure Time Per 24 Hours (hours/hours)	Exposure Frequency Per 365 Days (day/day)	Inhalation Absorption Adjustment Factor	Body Weight (kg)	Average Daily Dose (mg/kg-day)
Tetrachloroethene	2.79E-02	15.0	1	1.00E+00	9.59E-01	1	70	5.73E-03
Trichloroethene	6.00E-04	15.0	1	1.00E+00	9.59E-01	0.35	70	4.32E-05
trans-1,2-Dichloroethene	1.80E-04	15.0	1	1.00E+00	9.59E-01	1	70	3.70E-05
cis-1,2-Dichloroethene	1.80E-04	15.0	1	1.00E+00	9.59E-01	1	70	3.70E-05
Vinyle Chloride	2.00E-05	15.0	1	1.00E+00	9.59E-01	1	70	4.11E-06

POTENTIAL NONCARCINOGENIC HAZARD INDEX ASSOCIATED WITH INHALATION OF AIR

Average Daily Dose From Potential Inhalation Of Air

CHEMICAL	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	Adult ADDinhalation (mg/kg-day)	Averaging Time Adult (years/years)	Chronic ADDinhalation (mg/kg-day)	Inhalation Reference Dose (mg/kg-day)	Hazard Index Inhalation
Tetrachloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.73E-03	1.00E+00	5.73E-03	1.00E-02	5.73E-01
Trichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.32E-05	1.00E+00	4.32E-05	ND	ND
trans-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.70E-05	1.00E+00	3.70E-05	2.00E-02	1.85E-03
cis-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.70E-05	1.00E+00	3.70E-05	1.00E-02	3.70E-03
Vinyle Chloride	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.11E-06	1.00E+00	4.11E-06	ND	ND

POTENTIAL NONCARCINOGENIC HAZARD INDEX ASSOCIATED WITH INHALATION AND INGESTION OF CHEMICALS IN AIR

CHEMICAL	Hazard Index Inhalation	Hazard Index Ingestion	Total Hazard Index
Tetrachloroethene	5.73E-01	0.00E+00	5.73E-01
Trichloroethene	ND	0.00E+00	NA
trans-1,2-Dichloroethene	1.85E-03	0.00E+00	1.85E-03
cis-1,2-Dichloroethene	3.70E-03	0.00E+00	3.70E-03
Vinyle Chloride	ND	N.D.	N.D.
Total =	5.79E-01	0.00E+00	5.79E-01

NE-1NC.WQ1 25-Mar-92 R.N.: 02

SOURCE: ENSR 1990

Risk Assessment Calculations
Noncarcinogenic Assessment
Subchronic 24 Hour Upstairs Exposure

NE1SNC.WQ1 25-Mar-92
R.N.: 02
Envirocon

Noncarcinogenic Assessment
Exposure By Inhalation and Ingestion Of Chemicals In Air (Upstairs 24-Hour Subchronic)

CHEMICAL-RELATED VARIABLES Chemical	Chemical Concentration In Air (mg/m3 air)	Lung Retention Factor	Inhaled Particle Ingestion Factor	Inhalation Absorption Adjustment Factor	Oral Absorption Adjustment Factor	Inhalation Reference Dose (mg/kg-day)	Oral Reference Dose (mg/kg-day)
Tetrachloroethene	2.79E-02	1	0	1	1	1.00E-01	1.00E-01
Trichloroethene	6.00E-04	1	0	0.35	1	ND	ND
trans-1,2-Dichloroethene	1.80E-04	1	0	1	1	2.00E-01	2.00E-01
cis-1,2-Dichloroethene	1.80E-04	1	0	1	1	1.00E-01	1.00E-01
Vinyle Chloride	2.00E-05	1	0	1	1	ND	ND

```
+---------------------------------------+
|Enter Receptor Names:                  |
|                                       |
|Receptor #1:                           |
|Receptor #2:                           |
|Receptor #3:          Adult            |
+---------------------------------------+


Assumptions for
Noncarcinogenic Assessment
Exposure By Inhalation and Ingestion Of Chemicals In Air (Upstairs 24-Hour Subchronic)    Assumed Value   (units)
=======================================================================                   ================================
Inhalation Rate                                                                                 NA (m3 air/day)
Inhalation Rate                                                                                 NA (m3 air/day)
Inhalation Rate                  Adult                                                          15 (m3 air/day)
Body Weight                                                                                     70 (kg)
Body Weight                                                                                     70 (kg)
Body Weight                      Adult                                                          70 (kg)
Exposure Time                                                                                   NA (hrs)/24 hrs) =  0.00E+00
Exposure Time                                                                                   NA (hrs)/24 hrs) =  0.00E+00
Exposure Time                    Adult                                                          24 (hrs)/24 hrs) =  1.00E+00
Exposure Frequency                                                                              NA (days)/365 days =0.00E+00
Exposure Frequency                                                                              NA (days)/365 days =0.00E+00
Exposure Frequency               Adult                                                         350 (days)/365 days =9.59E-01
Exposure Duration                                                                               NA (yrs)/69 (yrs) = 0.00E+00
Exposure Duration                                                                               NA (yrs)/69 (yrs) = 0.00E+00
Exposure Duration                Adult                                                           1 (yrs)/69 (yrs) = 1.00E+00
Total Exposure Duration                                                                          1 (years)
```

Potential Noncarcinogenic Hazard Index Associated With Potential Inhalation And Ingestion Of Chemicals In Air

The average daily dose (ADD) from inhalation of air is calculated for each receptor using the following equation:

```
       ADDinh =  Chemical         * Inhalation    * Lung          * Exposure        * Exposure        * Inhalation     / Body
   (mg/kg-day)   Concentration      Rate            Retention       Time Per          Frequency         Absorption       Weight
                 In Air             (m3 air/day)    Factor          24 Hours          Per 365 Days      Adjustment       (kg)
                 (mg/m3 air)                                        (hours/hours)     (day/day)         Factor
```

The average daily dose (ADD) from ingestion of entrained particles in air is calculated using the following equation:

```
       ADDing =  Chemical         * Inhalation    * Inhaled       * Exposure        * Exposure        * Oral           / Body
   (mg/kg-day)   Concentration      Rate            Particle        Time Per          Frequency         Absorption       Weight
                 In Air             (m3 air/day)    Ingestion       24 Hours          Per 365 Days      Adjustment       (kg)
                 (mg/m3 air)                        Factor          (hours/hours)     (day/day)         Factor
```

The chronic average daily dose (CADD) is calculated for each pathway using the following equation, where:

```
Receptor #1 (R1) =
Receptor #2 (R2) =
Receptor #3 (R3) =       Adult



Averaging Time =         AT              Where: AT = Exposure Duration/Total Exposure Duration
                                                       (year)          (year)

          CADD =  (ADD,R1 * AT,R1)  +  (ADD,R2 * AT,R2)  +  (ADD,R3 * AT,R3)
   (mg/kg-day)   (mg/kg-day)            (mg/kg-day)           (mg/kg-day)
```

The hazard index associated with inhalation is calculated using the following equation:

```
      Hazard Index =  CADDInhalation  / Inhalation RfD
        inhalation    (mg/kg-day)       (mg/kg-day)
```

The hazard index associated with ingestion of entrained particles is calculated using the following equation:

```
      Hazard Index =  CADDIngestion   / Oral RfD
         ingestion    (mg/kg-day)       (mg/kg-day)
```

The total hazard index is calculated using the following equation:

```
             Total =  Hazard Index    + Hazard Index
      Hazard Index    Inhalation        Ingestion
```

Inhalation - Chronic Exposures
Noncarcinogenic Assessment
Adult

CHEMICAL	Chemical Concentration In Air (mg/m3 air)	Inhalation Rate (m3 air/day)	Lung Retention Factor	Exposure Time Per 24 Hours (hours/hours)	Exposure Frequency Per 365 Days (day/day)	Inhalation Absorption Adjustment Factor	Body Weight (kg)	Average Daily Dose (mg/kg-day)
Tetrachloroethene	2.79E-02	15.0	1	1.00E+00	9.59E-01	1	70	5.73E-03
Trichloroethene	6.00E-04	15.0	1	1.00E+00	9.59E-01	0.35	70	4.32E-05
trans-1,2-Dichloroethene	1.80E-04	15.0	1	1.00E+00	9.59E-01	1	70	3.70E-05
cis-1,2-Dichloroethene	1.80E-04	15.0	1	1.00E+00	9.59E-01	1	70	3.70E-05
Vinyle Chloride	2.00E-05	15.0	1	1.00E+00	9.59E-01	1	70	4.11E-06

POTENTIAL NONCARCINOGENIC HAZARD INDEX ASSOCIATED WITH INHALATION OF AIR

Average Daily Dose From Potential Inhalation Of Air

CHEMICAL	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	ADDinhalation (mg/kg-day)	Averaging Time (years/years)	Adult ADDinhalation (mg/kg-day)	Averaging Time Adult (years/years)	Chronic ADDinhalation (mg/kg-day)	Inhalation Reference Dose (mg/kg-day)	Hazard Index Inhalation
Tetrachloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.73E-03	1.00E+00	5.73E-03	1.00E-01	5.73E-02
Trichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.32E-05	1.00E+00	4.32E-05	ND	ND
trans-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.70E-05	1.00E+00	3.70E-05	2.00E-01	1.85E-04
cis-1,2-Dichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.70E-05	1.00E+00	3.70E-05	1.00E-01	3.70E-04
Vinyle Chloride	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.11E-06	1.00E+00	4.11E-06	ND	ND

POTENTIAL NONCARCINOGENIC HAZARD INDEX ASSOCIATED WITH INHALATION AND INGESTION OF CHEMICALS IN AIR

CHEMICAL	Hazard Index Inhalation	Hazard Index Ingestion	Total Hazard Index
Tetrachloroethene	5.73E-02	0.00E+00	5.73E-02
Trichloroethene	ND	ND	ND
trans-1,2-Dichloroethene	1.85E-04	0.00E+00	1.85E-04
cis-1,2-Dichloroethene	3.70E-04	0.00E+00	3.70E-04
Vinyle Chloride	ND	N.D.	N.D.
Total =	5.79E-02	0.00E+00	5.79E-02

NE1SNC.WQ1 25-Mar-92 R.N.: 02

SOURCE: ENSR 1990